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Growth data compiled in this study were collected by using pigs farrowed during the fall, 1963 and spring, 1964 farrowing seasons of the Oregon State University swine herd. Thirty-seven trios of light-, medium- and heavy-birth-weight suckling pigs were used to determine the effect of birth weight on subsequent rate of gain under conventional preweaning management conditions. Thirteen pairs of light- and moderate-birth-weight pigs reared from an initial average weight of 8.5 pounds were used to determine the effect of birth weight on rate of gain under a laboratory environment and to compare the relative feed consumption and efficiency of feed utilization under this same environment.

For conventionally reared pigs, a significant difference ($P < .05$) was found between the birth weight groups for the number of days required to grow from 4 to 15 pounds; pigs of heavier birth weights required significantly fewer days.

A significant difference ($P < .05$) was found between birth weight groups for average daily gain from birth to 25 pounds with the pigs of light birth weights gaining more slowly than pigs of heavier birth weights.

Highly significant ($P < .01$) correlation coefficients were found for birth weight with total gain to 56 days and birth weight with the number of days required to grow from 4 to 15 pounds. Birth weight was significantly ($P < .05$) correlated with average daily gain from birth to 25 pounds. No association ($P > .05$) was found for birth weight with the number of days required to grow from 10 to 25 pounds or for the number of days required to grow from 4 to 25 pounds.

No significant difference ($P > .05$) was found between birth weight groups for the number of days required to grow from 10 to 25 pounds or from 4 to 25 pounds. The conclusion was drawn that pigs of light birth weight are adversely affected by neonatal environmental conditions in the expression of their ability to grow but become equally as competent as their initially heavier litter mates in this respect during later preweaning life.

Under laboratory conditions, no significant differences ($P > .05$) occurred between pigs of light and moderate birth weights, for rate of gain, total feed consumption or efficiency of feed utilization. From these data it was concluded that: (1) pigs of light birth weight have the innate capacity to grow as rapidly, and with as much efficiency, as pigs of heavier birth weight; (2) the use of a weight constant preweaning test period seems to more accurately indicate actual genotypic differences of pigs than does an age constant test period; (3) when given environmental conditions which adequately provide for their needs, pigs of light birth weight are as economically productive as their littermates which were heavier at birth; and (4) pigs of light birth weight are not genetically inferior and, for this reason, their use in a selection program can increase the number of animals from which selections can be made, with consequent increased opportunity for efficiency of select ion.

THE RELATIONSHIP OF INITIAL WEIGHT TO GROWTH RATE IN PREWEANING PIGS

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INTRODUCTION

To obtain the highest possible net return per unit of production, the swine producer must produce efficiently and most profitably. Females normally ovulate many eggs at each estrus and thus many pigs are produced at each farrowing. The number of pigs born in a litter varies from one to more than twenty, with nine to ten being average. This level of prolificacy, however, is not synonomous with a high reproductive efficiency, for it is generally agreed that only 55 to 65 percent of the total number of ova shed result in pigs born alive.

In average herds approximately 18 percent of all pigs farrowed fail to survive to weaning, and it is generally recognized that birth weight influences survival ability. In general, birth weights follow a normal distribution. Birth weights average 2.8 pounds, and range from slightly less than one pound to about 4.5 pounds. It is recognized that there is a critical point of birth weights below which pigs do not usually survive. Vestal (42), for example, found that only 37.6 percent of all pigs with birth weights of less than two pounds survived to weaning, whereas 76.6 percent of all pigs born above two pounds survived. Approximately 20 percent of all pigs farrowed are in the low-birth-weight category. Thus, deaths within litters are disproportionately greater among the smaller pigs.

It is generally recognized that the majority of pre-weaning deaths occur during the first week of life. Inasmuch as all pigs which are born alive lived from conception to farrowing, it appears that the death of lighter pigs occurs primarily because of their inability to cope with neonatal environment. The larger, more vigorous pigs are apparently more competent in this respect.

From an economic standpoint, the number of pigs marketed per litter is of great importance. Bauman et al. (3) have shown that the returns, above feed and labor costs, from five to seven pigs per litter at weaning are absorbed by overhead costs. This means that the income in excess of feed and labor costs in a litter of more than five to seven pigs is returned to management. Because the heritability of litter size is low, the producer must depend mainly on managerial ability to enable him to market an increased number of pigs per litter.

In former years it was considered sound management to destroy pigs of light birth weight because it was felt that they would (1) decrease the amount of milk available to the larger, faster growing pigs, (2) die before weaning, or (3) if they lived, be inefficient (32). England et al. (19) have shown, however, that given a proper environment, 96 percent of all live pigs born could be raised to weaning. Thus, the number of pigs raised per litter can be increased by application of improved management procedures that meet the environmental needs of the smaller pigs.

With the recognition that (1) producing large numbers of pigs per litter is of economic importance, (2) only slow progress can be expected from selection for increased litter size, and (3) that pigs of light birth weight can, with extra care, be raised, a question arises concerning the economic value of the light-birth-weight pigs.

It is generally recognized that there are statistically significant positive correlations between birth weight and rate of gain to a subsequent age or weight. It is also established that pigs that grow faster generally make their gains on less feed per unit of growth. It has recently been shown (5; 9), however, that if post-weaning growth is computed on a weight-constant basis from 60 to 200 pounds, pigs of light birth weight grow as rapidly and efficiently as pigs of heavier birth weights.

The main objectives of the present study are:

1. To determine the relationship of birth weight to preweaning growth rate, when growth is measured on a weight-constant basis, under usual production conditions. The findings will indicate the ability of light-birth-weight pigs to grow in a conventional environment.

2. To ascertain the rate and efficiency of gains, on a

weight-constant basis, of light- and heavy-birth-weight pigs in a laboratory environment. The results will indicate the relative capacity for growth possessed by the pigs of light and heavy birth weights.

The information obtained should help determine the effects of size or weight *per se* on capacity of pigs to grow and use feed efficiently. If the pigs of low birth weights can grow with economic efficiency, some changes in commercial husbandry practices will be justified. But equally important, if it is shown that there is no genetic inferiority for performance ability in pigs of light birth weights, then these pigs could, through suitable performance testing procedures, be included in the selection of breeding stock. This in turn would raise the effective number from which to select and thereby provide opportunity for increased efficiency of selection.

REVIEW OF LITERATURE

The factors which affect the growth of the light-birth-weight pig and its ability to fit into an economic breeding program come from various sources and during various periods of life. In order to gain a clearer understanding of the forces acting upon the pig, the literature will be reviewed in three distinct phases: (1) those factors influencing prenatal development; (2) those factors influencing neonatal and postnatal development; and (3) those procedures influencing the acceptance of pigs into the breeding herd.

Factors Influencing Prenatal Development in Swine

Litter size greatly affects individual birth weights (7, p. 89; 42, p. 41). Average litter size approximates 9.1 pigs but large deviations occur (7, p. 89; 42, p. 41). Because large variations in litter size occur, it is necessary to understand the factors affecting litter size which, in turn, could influence birth weight.

Rathnasabapathy *et al*. (38, p. 16) found that ovulation rate and fetal mortality were the two main factors which controlled litter size in swine. Ovulation rate exerts its control by setting the upper limit of litter size possible, while fetal mortality determines the actual number of piglets born during a certain farrowing (41, p. 16). For this reason, Squiers *et al*. (41, p. 16) maintain that fetal mortality exerts more influence on actual litter size than does ovulation rate.

Age of dam effects contribute greatly to ovulation rate; it has been shown that gilts ovulate fewer total ova than sows, and that the ovulation rate of sows increases with age up to eight years of age (35, p. 312). Perry (35, p. 310) found that sows over two years of age ovulated an average of 19.6 ova per estrus, while gilts averaged 13.6 ova. Rathnasabapathy et al. (38, p. 11) concur with Perry in that they found that gilts ovulated an average of 11.5 ova and sows ovulated an average of 15.0 ova.

Baker et al. (1) found significant differences in ovulation rates between sows of different breeds. Godbey and Godley (23, p. 12) demonstrated that inbreeding has a depressing effect on ovulation, as on other traits associated with reproduction. It was found that there was a reduction of 0.8 pig for every ten percent inbreeding (23, p. 12). Chapman (8, p. 74), however, found no such effect on litter size in the Oregon State University swine herd.

Other factors which may have an effect on ovulation rate are age at puberty (35, p. 34), nutrient levels prior to ovulation (43), season of the year (41, p. 10) and crossbreeding (41, p. 27).

Squiers (41, p. 24) and Perry (35, p. 320) indicate that 40 to 46 percent of all ova shed are lost prior to parturition. Since 95 percent of all ova shed are fertilized, the remaining 30 to 35 percent mortality represents inadequacies in the fetal environment (41, p. 24). Several explanations have been presented to account for the causes of such a high mortality rate, with the most widely accepted one being fetal crowding (1; 38, p. 23; 43). Ibsen (27, p. 76-80) working with guinea pigs, found a depressing effect on fetal growth after the 50th day of pregnancy if there were more than three fetuses in the uterine horn. He also maintained that the total number of fetuses being carried influenced the development of those in each horn; the total number competed for the available nutrients and thus affected each individual fetus. Waldorf et al. (43), however, maintain that in swine the number of fetuses per horn is more influential than total litter size.

With regard to crowding per se, Baker et al. (1) indicates that factors which favor a high ovulation rate may also favor rapid embryo growth. Later in pregnancy, however, due to crowding and competition, these same factors may depress growth. Furthermore, the crowding may initiate a depressing mechanism on placental proliferation. Waldorf et al. (43) found results along this line when they discovered that the fetal membranes grow, and are affected, in the same manner as the fetus.

Age of dam exerts an influence or embryonic mortality. It has been shown that with increasing age of dam there is a tendency for embryonic mortality to increase (35, p. 320). This would partially offset the large number of ova produced by older sows, resulting in a smaller difference in number of pigs born per litter between young and old sows. It was further shown (35, p. 20) that embryonic mortality tends to level off at four years of age, but it was postulated that this may be due to selection for prolificacy being almost complete by four years of age.

Anatomical differences also affect fetal growth and mortality. Rathnasabapathy et al. (38, p. 32) found a significant correlation of litter size at 55 days with length of uterus, but maintained that the forces determining the length of the uterus were under a great deal of environmental control.

Large variations in litter size, which, to a great extent, are under environmental controls, coupled with factors such as age of dam and inbreeding effects, result in a low heritability estimate for litter size. Estimates vary from -0.11 (25) to 0.59 (11) with 0.22 being average (29, p. 333). Heritability estimates for the Oregon State University swine herd are near the average of estimates reported and suggest that selection for larger litters would be relatively ineffective (8, p. 54).

The factors which influence fetal mortality, namely crowding and subsequent lack of nutrition, also seem to influence birth weights. In this regard, Dickinson (12) maintained that nutritional levels greatly influence the size of the fetus; if nutrient uptake is restricted there may be a delay in the growth pattern, which, in turn, could produce animals at birth with different physiological stages of growth.

Position in the uterus seems to be one of the main limiting factors in fetal growth, with the fetus and membranes at the extremes of a horn being larger than those toward the middle of the uterus (43). Furthermore, the proximity with which one fetus lies next to another greatly influences the relative amount of growth possible (43).

Litter size has a depressing effect on birth weight and percentage of pigs born alive. Carmichael and Rice (7, p. 86) found that seven percent of the pigs born in litters of less than seven were dead or immature, while in litters of eight or more 10.5 percent were born dead or immature. It was further shown that pigs from litters below average in number (8.1 pigs) averaged 2.74 pounds birth weight, whereas pigs from litters above average in number averaged 2.55 pounds at birth. Vestal's (42, p. 41) results with a large number of sows follow these same trends. Winters *et al.* (46) found a negative correlation of 0.32 between average birth weight and litter size. Lush *et al.* (29, p. 335) also found that smaller litters have heavier pigs, except in exceedingly small litters, in which case the piglets were usually very light. Lush *et al.* (29, p. 333) also reported that 40 percent of the variation in birth weight within litters is due to environmental influences not common to litter mates and that only three percent of the variation is due to the genotype of the pigs.

This would indicate that strong environmental influences such as fetal crowding and restriction of nutrients available to the fetus exert forces on pigs individually *in utero* (29, p. 340).

Age of dam exerts an influence on birth weight. Carmichael and Rice (7, p. 90) demonstrated that pigs from sows under two years of age farrowed pigs averaging 2. 4 pounds, while pigs from sows over two years averaged 2. 6 pounds.

Again, presumably because of large environmental effects, the ability to select for birth weight is low. Heritability estimates vary from 0. 0 to 0. 29 (25), with 0. 14 being average (34, p. 270).

Menzies-Kitchin (32, p. 614) found that as a result of decreased birth weight pigs from larger litters are usually less vigorous and have a higher percentage of mortality. While generally concurring with this, Vestal (42, p. 40) and Winters *et al.* (46) found that the majority of preweaning deaths are associated primarily with birth weight and not litter size *per se*. It was further shown by Vestal that all pigs with a birth weight of one pound or less died before weaning, and of those that weighed two pounds or less 62. 4 percent died before weaning. Since 18. 5 percent of 7, 554 pigs born were in the latter category, the death of light piglets accounted for a disproportionate number of preweaning deaths. In a similar study, Fredeen and Plank (22) showed that there was 44 percent mortality in the birth weight group of 2. 5 pounds or less, and a mortality of only

12 percent in the birth weight group above 2.5 pounds. Pomeroy (36, p. 53) reported that two pounds is a critical point below which piglets do not usually survive.

Factors Influencing Neonatal and Postnatal Development

The occurrence of such a high mortality rate of piglets of less than 2.0 pounds birth weight (42) has prompted a number of postulations regarding the factors that influence the mortality and growth of the light pig.

The most critical period of life for the newborn pig is the first three days of life (36, p. 54). Pomeroy's (36, p. 54) data showed that 70 to 72 percent of all preweaning deaths occur at this time and, furthermore, that 83 percent of the preweaning deaths of pigs of light birth weight occur at this time. Pomeroy further postulates that the greater relative mortality shown by pigs of light birth weight is due to the fact that the undersized pig is less vigorous, especially during the first three days of life. Because of its lower vigor, the smaller pig is more susceptible to chilling, starvation, and crushing by the sow (36, p. 35).

Body temperature exerts a large influence on the degree of activity shown by newborn pigs (33, p. 120). Newland (33, p. 121) found that the body temperature of the neonatal pig drops rapidly within an hour after birth and attributed this to the evaporation of amniotic fluids. The body temperature of a heavy-birth-weight pig then returns to normal in an average of four days. In the light-birth-weight pig, however, the thermoregulating mechanism does not become active as rapidly and it takes up to ten days for the body temperature to return to normal (33, p. 122). Newland (33, p. 130) postulates that because the light-birth-weight pig has proportionately more surface area it must produce more heat per unit of body weight in order to maintain the same temperature. The smaller pig also utilizes its total body reserves at a faster rate and thus becomes chilled and comatose more rapidly. Furthermore, because it is lethargic, the lighter-birth-weight pig consumes less milk at each nursing and nurses less often, which in turn, results in less energy being available to prevent chilling and starvation (37). England and Chapman (18) maintain that the causes of mortality in weaker pigs indicate that death is due to environmental conditions rather than to the lack of genetic ability to survive. These workers reported that hand feeding of weaker pigs and the use of heat lamps lowers the incidence of preweaning mortality to as low as about ten percent (20).

Milk consumption seems to be the prime factor determining growth rate of the preweaning pig although social factors may exert a great influence (10). Comstock *et al.* (10) maintain that differences in ability to nurse caused differences in three and eight week weights and, furthermore, that differences in ability to nurse come from variation in appetites. England et al. (19), working with artificially raised pigs, found a positive association of birth weight with volume of milk consumed. It was also shown that the average increase in milk intake, for the first five days of life, was at a more rapid rate in pigs of heavier birth weights. Donald (13, p. 359) also found that the heavier pigs in a litter consumed more milk. Using a milking machine, Hartman et al. (26) obtained results from which they proposed that larger preweaning pigs actually consume more milk because their larger appetites cause them to do a more complete job of removing milk, which in turn stimulates a heavier milk flow. It is interesting to note, however, that England et al. (19) found that the intake of milk per unit of body weight for pigs fed individually with a bottle was negatively correlated with average body weight (-0.28), and that lighter pigs actually consumed more milk in relation to their body size. Rose (39, p. 35), by comparing weights of pigs before and after nursing, found no correlation between birth weight and milk consumption from 14 to 42 days of age for pigs nursing their dams.

Donald (15), in an early study undertaken to determine the amount of influence of nursing position on milk consumption, found that each pig regularly nurses a particular udder section and that pigs have a tendency to nurse only the udder sections that they have claimed. McBride (31) concluded that competition played a major role in the allocation of udder sections to pigs and that the larger, more vigorous pigs competed more adequately for the desired positions. McBride (31) also concluded that sounds coming from the sow, and size of teat also encouraged competition for the more anterior quarters (31). McBride (30) found a positive association between birth weight and udder section nursed, with heavier pigs nursing more anteriorly. England *et al.* (17) found that the majority of the pigs nursed at the more anterior sections, but found that pigs of significantly heavier birth weights nursed at udder positions three and four. It is of further interest to note that in this experiment there was a tendency for the larger rather than the smaller pigs to nurse at posterior teats.

Donald (14, p. 366) and Hartman *et al.* (26), working with small numbers, found that anterior udder sections produce more milk and postulated that for this reason bigger pigs are usually found here. Rose (39, p. 35), however, working with 32 litters found a significant difference in production only between udder sections one and six and four and six. England *et al.* (17) postulated that while there is no association between udder section nursed and birth weight, it still may hold that the lighter-birth-weight pigs receive the udder sections which produce less milk. A later study by England and Rose, however, refutes this postulation (20).

With regard to efficiency of milk utilization, Donald (13) proposed that piglets receiving the most milk above their requirements for maintenance convert the extra milk more efficiently. England *et al.* (19), however, working with artificially reared pigs under laboratory conditions, found that pigs of low birth weight required 19.2 ml of milk per .01 pound gain and piglets of heavier birth weight required 26.1 ml of milk per .01 pound gain. Although these data ignore differences in total maintenance requirements, they still indicate that pigs of low birth weight are capable of efficient production (19).

Factors Affecting Acceptance as Breeding Animals

The use of age constant periods for the evaluation of swine has been in use for many years. Menzies-Kitchin (32, p. 625), as early as 1937, showed that pigs which were heaviest at weaning time were also heaviest at slaughter on an age constant basis and that there was a significant negative correlation between the weight of a pig at six weeks of age and its age at slaughter. In support of this, several workers (22; 42, p. 40; 44) maintained that there is a direct relationship between birth weight and weaning weight, with those pigs which were large and vigorous at birth usually weighing more at a standard weaning age.

It has been maintained that a knowledge of the relationships between weight at certain times, especially in early life, should be of great value in predicting performance (4) and potential breeding value of swine (24). Toward this end, much work has been done to determine the relationship of birth weight with subsequent performance. Winters et al. (46) found that weaning weight of a litter increased 15.9 pounds with an increase of one pound in the average birth weight of the entire litter, when size of litter was held constant, and weaning was on an age basis. On an individual basis, Blunn et al. (4) found the correlation of birth weight and gain from birth to 56 days to be 0.44, and of birth weight and 56-day weight to be 0.53, indicating a very strong association of birth weight with subsequent growth rate. These workers further maintained, however, that correlations between weight at a given age and weight at a later age are somewhat automatic, since the earlier weight is part of the later. Forshaw et al. (21) support Blunn et al. (4), in that they found a correlation of birth weight and weaning at eight weeks of 0.46. They also determined that for every one pound change in birth weight there was a change of 7.8 pounds in weight at eight weeks. Godley and Godbey (24) found a correlation of birth weight with weaning weight of 0.47.

Whatley (45, p. 253) found a correlation of birth weight with 180-day weight of 0.43, but also found a correlation of weaning weight with 180-day weight of 0.55. He concluded that weaning weight is twice as useful as birth weight in predicting weight at 180 days, due mainly to the effect that environment plays in prenatal and preweaning growth. Donald (14) concluded that weaning weights did not discriminate between the quality of the sow and the litter and, for this reason, were ambiguous. Nordskog *et al.* (34, p. 270) reported that weaning weight is mainly a good measure of a sow's milking ability.

Bywaters (6, p. 468) computed the causes of variation in weaning weights and found that 42 percent is due to environmental factors not common to litter mates, and that only 18 percent of the variation in weaning weight is due to genetic variation. Baker *et al.* (2) concur with Bywaters, as they found that the portion of the variation in weight at 56 days which could be attributed to genetic causes was four percent, while the amount of variation caused by environment common only to the individual caused 46 percent of the variation. Thus, the part environment plays from birth to weaning is quite large. Heritability estimates are low for weaning weight; they range from .074 (11) to 0.35 (16). Again, these computations were made on an age or time constant basis and are influenced by greater environmental effects at this young age. A decrease in environmental effects, such as those occurring in later life, results in a higher heritability estimate.

Because differences in postweaning gains of pigs calculated on an age constant basis are quite dependent upon weaning weight, Chapman and England (9) questioned whether size per se influences the association of weaning weight with postweaning rate of gain. In an earlier study, England and Chapman (18) reported that on a weight constant basis, during a period from 50 to 100 pounds, there was no difference in rate of gain found between pigs which had light and heavy weaning weights. Boaz and Elsley (5, p. 22) found an advantage in growth rate for the heavy weaning pig up to 60 pounds, but from 60 to 200 pounds found no difference in rate of gain between the light and heavy weaning groups. They further showed that no difference between the two groups occurred in feed efficiency.

Chapman and England (9) working with 133 pigs, found a correlation of 0.41 between weaning weight and postweaning growth rate on an age-constant basis. When postweaning gains were calculated on a constant weight of 60 pounds to 150 pounds the correlation was reduced to a non-significant value of 0.17. Furthermore, and in agreement with Boaz and Elsley, there was no significant difference in rate of gain from 60 to 200 pounds between the light and heavy weaners. It was concluded that differences in size at the beginning of a test will obscure differences in capacity for postweaning growth, and that calculating gains on a weight-constant basis gives a more adequate picture of genetic capacity for growth.

Although the literature cited above is good evidence that the majority of the causes for variations in growth are due to environmental factors, no data are available to show the effect of initial weight *per se* on the performance of preweaning pigs. Compilation of information of this nature should add to the knowledge of the genetic capacity for growth of pigs in general, and pigs of light-birth-weight in particular.

MATERIALS AND METHODS

The information contained within this study was obtained by using pigs born during the fall, 1963 and spring, 1964 farrowing seasons of the Oregon State University swine herd. Twenty four litters from the fall, and 17 litters from the spring farrowing were represented.

The experiment was composed of two trials. The first was used to study the growth of pigs nursing their dams under usual management conditions in the Oregon State University swine herd. The purpose of the second trial was to study the growth of pigs of different birth weights in a laboratory environment with individual full feeding. The two trials will be described separately.

Method of Herd Management

Approximately three days before farrowing, sows were scrubbed with a disinfectant solution and placed in conventional farrowing crates. Following procedures used in the university herd, sows were attended while farrowing and baby pigs were weighed, ear notched, and had needle teeth removed on the day of birth. All small or weak pigs were given assistance in locating a teat and securing adequate amounts of colostrum. In addition, pigs which experienced difficulty in getting sufficient amounts of milk were bottle fed commercial sow milk replacer. The farrowing crate contained warm, dry, draft free sleeping areas. To prevent anemia all pigs were injected with one ml of iron dextran containing 100 mg elemental iron when three days of age. When pigs reached approximately ten days of age, the sow and litter were moved from the farrowing unit to conventional pens. In this area, the baby pigs were provided with hovers which had heat lamps. Pigs were creep fed after six weeks of age, but had access to sow feed during the entire preweaning period.

Pigs were weighed once weekly from birth to six weeks of age and again at 56 days of age. The weight at one week of age included variations in age of up to two days, however. This occurred because, in order to facilitate weighing procedures, all pigs were weighed on one of two days during the week.

Pigs Raised Under Conventional Conditions

In all, 111 pigs from 24 fall and 10 spring farrowed litters were compared. Thirty-seven pigs with birth weights of 2.0 pounds or less (light group) were compared with 37 pigs with birth weights of 2.6-2.9 pounds (medium group) and 37 pigs with birth weights of 3.5 pounds or greater (heavy group). These three birth weight categories were chosen because they represent the average and the two extremes of birth weight distribution. Although treated as groups in the analysis, the pigs were allocated to the test as trios of light-, medium- and heavy-birth-weight pigs, based on the litter size and breeding background of the pigs from the light-birth-weight group. In 10 of the 37 trios all three pigs compared were from the same litter. In the remaining 27 comparisons it was not possible to obtain both of the other members of the trio from the same litter that contained the light pig. In these instances, pigs of the appropriate birth weight groups from other litters of comparable size and breeding were randomly selected to make up the trio.

Comparisons of the three birth weight groups were made on weight-constant bases. Two distinct growth periods were chosen; from 4 to 15 pounds and from 10 to 25 pounds. The former was chosen because (1) this is an early stage of post-natal growth and may reflect a more sensitive effect of initial size differences than at a later stage, and (2) the pigs consume more milk than creep feed during this time. The lower limit of four pounds represents the birth weight of the heavy group, and was chosen in order to include all pigs in the comparison. The period from 10 to 25 pounds was chosen because it includes a change from maximum milk consumption to increased food consumption and a less adequate milk supply. The upper limit of 25 pounds represents the weaning (56 day) weight of the light group and, again, was used in order to include all pigs in the comparison.

A third comparison included the total growth period from 4 to 25 pounds. A final comparison was that of average daily gain from birth to 25 pounds.

Correlation coefficients were used to express the relationship of birth weight with the number of days required to grow from: (1) 4 to 15 pounds, (2) 10 to 25 pounds, and (3) 4 to 25 pounds.

A fourth correlation coefficient was used to express the relationship between birth weight and average daily gain from birth to 25 pounds. Analysis of variance was used to test for significance of differences between birth weight groups and between trios for the growth periods of 4 to 15 pounds, 10 to 25 pounds, 4 to 25 pounds and average daily gain from birth to 25 pounds.

In very few instances did any pigs weigh exactly 4, 10, 15 or 25 pounds on any given date. It was, therefore, necessary to adjust the actual weight to the needed weight. This was done by computing the average daily gain for the seven day period surrounding the desired weight and then computing the number of days necessary to reach the needed weight from the actual weight closest to the needed weight. For example, if a pig weighed 3.3 and 6.4 pounds at 7 and 14 days, respectively, then it had a rate of gain of 0.44 pounds per day and weighed 4.18 pounds at nine days of age. Nine days was then taken as the age at four pounds weight. Similarly, if the pig weighed 13.5 and 16.3 pounds at 35 and 42 days, respectively, then it had a rate of gain of 0.40 pounds per day and weighed 15.1 pounds at 39 days of age. Thirty-nine days was then taken as the age at 15 pounds weight, and the total period from 4 to 15 pounds was 30 days.

Pigs Raised in a Laboratory Environment

In the second trial, the growth, feed intake and efficiency of feed utilization of 13 pigs of light birth weight were compared to that of 13 pigs weighing over 2.3 pounds each at birth (moderate group). All pigs used were from spring farrowed litters. Pigs in the moderate group were selected at random from within the same litters as the selected light pigs in all but two cases.

The pigs remained with the sow and were weighed weekly until they reached an average weight of 8.5 pounds. At that time they were removed from the sow and taken to a laboratory environment. In the laboratory, these pigs were housed in a closed building which contained no other swine and was away from the swine barn. Temperature was not held constant but fluctuated relatively little as compared with that encountered at the swine barn. The pigs were kept individually in cages with expanded metal floors.

The pigs were on test 17 days each, and during this time were fed commercial sow milk replacer *ad libitum*. During the first three days of the test, milk was mixed to 75 percent of the recommended concentration. This was done to minimize the incidence of scouring due to an abrupt change in nutrition. From the fourth day until the end of the test, the pigs were fed milk replacer mixed as recommended by the manufacturer. Measured amounts of milk were fed in metal pans three times daily. Twice daily the refused amounts were measured back and net consumption was computed. Refused milk was not reused. Milk pans were washed and disinfected twice daily. Milk wastage appeared to be minimal and was not considered to be an important factor insofar as differences between birth weight groups was concerned.

The pigs were individually weighed on and off test. Net gains were computed on a time-constant basis. A beam type scale, graduated in grams, was used. Pigs were weighed in a deep plastic basket in the morning and milk from the previous night's feeding was available to them prior to weighing.

Scours, which occurred with varying severity, were controlled by the use of NF-180, Neomix and Tylocine.

Student's t test was used to test for significance of differences between the two groups for net gain, average daily milk consumption and feed efficiency.

RESULTS

Pigs Raised Under Conventional Conditions

The means and standard deviations of the growth periods, including birth weight, weaning weight, average daily gain from birth to 25 pounds and the number of days required to grow from 4 to 15, 10 to 25 and 4 to 25 pounds are given in Table 2.

The correlation of birth weight with net gain to 56 days (Table 3) is positive and highly significant ($r = 0.272$, $P < .01$). This is lower than most estimates found by other workers (4; 21; 24).

An analysis of variance between trios was computed to determine the occurrence of litter effect on the growth pattern of the trios used (Table 1). No significant difference ($P > .05$), with 36 and 74 degrees of freedom, was found between trios for rate of gain (1) from 4 to 15 pounds, (2) 10 to 25 pounds, (3) 4 to 25 pounds and (4) for average daily gain from birth to 25 pounds.

Growth from 4 to 15 pounds. The correlation coefficient of birth weight and number of days required to grow from 4 to 15 pounds during this weight-constant period is negative ($r = -0.256$) and highly significant ($P < .01$) (Table 3). This indicates that birth weight is associated with subsequent growth rate from 4 to 15 pounds. This is borne out by the regression coefficient of birth weight on the number

Table 1. Analysis of variance of growth rate during various periods between trios of light-, medium- and heavy-birth-weight preweaning pigs.

Source of Variation	d. f.	M. S.	F	Significance Level
Between Trios				
4-15 pounds	36	29. 14	0. 516	P > . 05
10-25 pounds	36	37. 81	0. 647	P > . 05
4-25 pounds	36	43. 75	0. 658	P > . 05
A. D. G. to 25 pounds	36	3. 50	0. 691	P > . 05
Within Trios				
4-15 pounds	74	57. 73		
10-25 pounds	74	58. 42		
4-25 pounds	74	66. 50		
A. D. G. to 25 pounds	74	5. 07		

Table 2. Means and standard deviations of birth weight, weaning weight, average daily gain from birth to 25 pounds and number of days required to grow from 4 to 15 pounds, 10 to 25 pounds and 4 to 25 pounds for suckling pigs of the birth weight classifications of light, medium and heavy.

Weight Classification	Light	Medium	Heavy	Average of Groups
Birth weight				
Mean	1.90	2.70	3.72	2.77
Standard deviation	0.64	0.34	0.73	0.77
Weaning weight				
Mean	26.8	29.2	33.5	29.8
Standard deviation	5.13	4.81	7.57	6.54
A.D.G. from birth to 25 pounds				
Mean (pounds per day)	0.42	0.44	0.47	0.45
Standard deviation	0.055	0.053	0.082	0.069
No. days from 4 to 15 pounds				
Mean	30.1	28.5	26.4	28.3
Standard deviation	4.75	6.34	5.56	5.75
No. days from 10 to 25 pounds				
Mean	29.9	30.7	31.1	30.5
Standard deviation	7.20	5.20	6.77	6.41
No. days from 4 to 25 pounds				
Mean	46.9	46.0	45.3	46.1
Standard deviation	9.43	7.03	9.78	8.81

Table 3. Correlation and regression coefficients between birth weight and five growth periods for suckling pigs raised under conventional conditions.

Traits	r	P	b
Birth weight - weaning weight	0.382	$< .01$	3.21 pounds
Birth weight - net gain to weaning	0.272	$< .01$	2.21 pounds
Birth weight - days 4 to 15 pounds	-0.256	$< .01$	-1.91 days
Birth weight - days 10 to 25 pounds	0.129	$> .05$	1.07 days
Birth weight - days 4 to 25 pounds	-0.0046	$> .05$	-0.046 days
Birth weight - A.D.G. birth to 25 pounds	0.227	$< .05$	0.02 pounds per day

of days required to grow from 4 to 15 pounds. The regression coefficient indicates that each additional pound in birth weight reduces the time required to grow from 4 to 15 pounds by 1.91 days (Table 3).

A significant difference ($P < .05$) was found between the three birth weight groups for rate of gain from 4 to 15 pounds (Table 4). By the method of least significant differences (L. S. D.) it was found that significant differences in rate of gain occur only between the light and heavy groups. There was no significant difference in rate of gain between the light and medium or heavy and medium groups (Table 5).

Growth from 10 to 25 pounds. A low, positive association ($r = 0.129$) was found between birth weight and the number of days required to grow from 10 to 25 pounds (Table 3). While not significant ($P > .05$), the correlation coefficient does indicate a change in the growth pattern exhibited by pigs of the three different birth-weight groups.

During the period from 4 to 15 pounds there was a statistically significant advantage for the pigs having a heavier birth weight. The regression coefficient of the number of days required to grow from 10 to 25 pounds on birth weight, however, would, if based on significant differences of the magnitude shown in Table 3, indicate that an increase in birth weight of one pound increases the time required to grow from 10 to 25 pounds by 1.07 days. The absence of a significant relationship between these traits indicates no advantage for

Table 4. Analysis of variance of number of days required to grow from 4 to 15 pounds between pigs of light, medium and heavy birth weights.

Source of Variation	d. f.	M. S.	F
Between birth weight groups	2	128. 0	4. 09*
Within birth weight groups	108	31. 3	
Total	110		

*Significant at $P < .05$

Table 5. Difference in means of number of days required to grow from 4 to 15 pounds between three birth weight groups.

Comparison	D
Light vs medium	1. 56
Medium vs heavy	2. 14
Light vs heavy	3. 70

L. S. D. ($P < .05$) = 2. 57 days

the pigs of heavier birth weight during this period.

No significant difference was found between birth weight groups for the number of days required to grow from 10 to 25 pounds (Table 6). This further points out that there has been a change in the growth pattern shown by the three groups in the period from 10 to 25 pounds as compared to the period from 4 to 15 pounds.

Growth from 4 to 25 pounds. A low, negative correlation coefficient ($r = -0.0046$, $P > .05$) indicates that there is no association of birth weight with rate of gain over the weight constant period from 4 to 25 pounds (Table 3). The regression coefficient of the number of days required to grow from 4 to 25 pounds on birth weight is -0.046.

No significant difference was found between the birth weight groups for rate of gain from 4 to 25 pounds (Table 7). This indicates that on a weight-constant basis, the pigs of light birth weight grow as rapidly as the pigs of medium or heavy birth weights from 4 to 25 pounds.

Average daily gain from birth to 25 pounds. There was a significant ($P < .05$), positive association ($r = 0.227$) between birth weight and average daily gain from birth to 25 pounds (Table 3). The regression coefficient of average daily gain to 25 pounds on birth weight was 0.02 (Table 3). This indicates that for every one pound change in birth weight there is a subsequent change of 0.02 pounds

Table 6. Analysis of variance of number of days required to grow from 10 to 25 pounds between pigs of light, medium and heavy birth weights.

Source of Variation	d. f.	M. S.	F
Between birth weight groups	2	14. 0	0. 336 N. S.
Within birth weight groups	108	41. 64	
Total	110		

P > . 05

Table 7. Analysis of variance of number of days required to grow from 4 to 25 pounds between pigs of light, medium and heavy birth weights.

Source of Variation	d. f.	M. S.	F
Between birth weight groups	2	23. 0	0. 391 N. S.
Within birth weight groups	108	58. 87	
Total	110		

P > . 05

per day in growth rate from birth to 25 pounds with the pigs of heavier birth weight showing the growth advantage.

The means of average daily gain from birth to 25 pounds of all three birth-weight groups are shown in Table 2. Although differences appear small, a significant difference was found between birth weight groups for average daily gain from birth to 25 pounds (Table 8). As shown in Table 9, a significant difference in rate of gain occurred only between pigs of light- and heavy-birth-weights, with the heavier pigs gaining more rapidly. No significant difference in rate of gain was found between the light and medium or heavy and medium groups.

Pigs Raised Under Laboratory Conditions

The average daily gain, net gain during the 17 day test period, daily milk consumption, and feed efficiency for pigs raised under a laboratory environment are given in Table 10. The results, computed by Student's t tests, indicate that no significant differences exists between the moderate and light groups for net gain, daily milk consumption or feed efficiency (Table 11).

Table 8. Analysis of variance of average daily gain from birth to 25 pounds between pigs of light, medium and heavy birth weights.

Source of Variation	d. f.	M. S.	F
Between birth weight groups	2	0. 0275	6. 71*
Within birth weight groups	108	0. 0041	
Total	110		

*Significant at P < . 01

Table 9. Difference in means of average daily gain from birth to 25 pounds between three birth weight groups.

Comparison	D
Light vs medium	0. 021
Medium vs heavy	0. 028
Light vs heavy	0. 049

L. S. D. (P < . 05) = 0. 0295 pounds per day

Table 10. Means of average daily gain, net gain, milk consumption and feed efficiency of two birth weight groups raised under a laboratory environment.

Birth Weight Group	Moderate	Light	Average
Birth weight (pounds)	2.74	1.63	2.18
Average daily gain (pounds per day)	0.68	0.66	0.67
Net gain (kg)	5.28	5.13	5.21
Milk consumption (l)	2.63	2.54	2.59
Feed efficiency (l per kg)	0.498	0.495	0.497

Table 11. Student's test for significance of differences of production traits between pigs of different birth weights raised in a laboratory environment.

Trait	t Value	Significance Level
Net gain	0.228	P > .05
Milk consumption	0.394	P > .05
Feed efficiency	0.098	P > .05

DISCUSSION

The correlation of birth weight with net gain to 56 days ($r = 0.272$, Table 3) for the 111 pigs comprised of 37 trios of pigs from the three birth-weight groups is lower than correlations of birth weight and weaning weight reported by other workers for entire litters (4; 21; 24). The coefficient of determination found in this study ($r^2 = 0.074$) indicates that on a time constant basis, variation in birth weights accounts for a smaller proportion of the variation in growth in this population than is usually found in other herds. When the correlation of birth weight with net gain to 56 days in the present study is based upon the entire litters from which the trios were taken its magnitude is greater ($r = 0.328$), but still lower than estimates reported in other studies.

One reason for the diminished magnitude of association of birth weight with net gain to 56 days found in this study is that in correlating birth weight and weaning weight, birth weight is included in weaning weight. This results in an association of two weights which are made up in part of the same weight (birth weight). The association of birth weight with net gain to 56 days removes birth weight from weaning weight and is therefore a more accurate measure of the association of birth weight and preweaning growth. The association of birth weight with weaning weight found in this study was

0.382 ($P < .01$, Table 3).

The use of heat lamps and the practice of feeding supplemental milk to small and weak pigs might also affect the association of birth weight with net gain to 56 days by enhancing the ability of light-birth-weight pigs to grow at a more rapid rate than is found under management conditions where this type of assistance is not given. If pigs of light birth weights gain more rapidly at a younger age they might weigh more at 56 days than if they had received no extra care, thereby decreasing the magnitude of the association of birth weight with net gain to 56 days. Such expectations appear to be borne out in the study by England and Chapman (18a) in which the correlation of birth weight and 56 day weight was only $r = 0.13$ for pigs reared from birth in a laboratory environment and fed artifically.

The occurrence of scours throughout the herd may also have affected the amount of association found, although scouring is probably found in most herds. Wide variations in severity of scouring occur, and it is possible that heavier, more rapidly growing pigs are more adversely affected than lighter pigs. No data are available to support this hypothesis, however.

The correlation of birth weight with average daily gain from birth to 25 pounds ($r = 0.227$, Table 3) indicates that birth weight is significantly associated with rate of gain from birth to 25 pounds. This is generally to be expected since pigs of heavier birth weight are required to gain less weight to reach 25 pounds. Furthermore, pigs which are heavier grow more rapidly on an age-constant basis. This enables them to maintain a more rapid rate of gain than the smaller pigs which grow more slowly during the same period because they are lighter.

Analysis of the significance of differences of means of the different birth-weight groups for the number of days required to grow from 4 to 15 pounds shows that the heavy group grows more rapidly during this weight-constant period (Table 5). No significant differences occur between the birth-weight groups for the number of days required to grow from 10 to 25 pounds (Table 6), or over the total number of days required to grow from 4 to 25 pounds (Table 7). These relationships indicate that pigs which are smaller at birth grow more slowly early in life, even on a weight constant basis, than do pigs which are heavier at birth. These relationships also indicate that at some time between four and ten pounds there is a change in the relative rates of gain of the three birth-weight groups.

Pomeroy's work (36, p. 54) on neonatal survival in swine indicates that pigs of light birth weight are less vigorous and adjust more slowly to changes encountered in their new environment. It has also been shown that the thermoregulating mechansim in pigs of light birth weight may take up to ten days to become stabilized, whereas in pigs of heavy birth weight it takes about four days

(33; 37). Pigs which are cold are less vigorous and since vitality influences milk consumption, it may be that the lighter pigs consume less milk because of secondary effects controlled by the adjusting thermoregulating mechanism.

England et al. (19), using pigs raised under laboratory conditions, reported that pigs which are heavier at birth consumed more milk from birth to five days of age. This should be expected since larger pigs have greater total capacity. It was further shown, however, that when given the opportunity to consume as much as they desired, the lighter pigs consumed more milk in relation to their body weight and utilized this milk as efficiently as the pigs which are heavier at birth (19). This work does not refute the possibility that under conventional conditions the pig of light birth weight may consume less milk per unit of body weight during the first few days of life. However, the additional care given pigs of light birth weight in the Oregon State University herd may offset some handicaps normally encountered under management conditions that are less adequate for the pigs of light birth weight.

The change in association of birth weight and rate of gain during the 4 to 15 pound and 10 to 25 pound periods is most marked between the light and heavy groups. Two postulations can be advanced to account for this change: (1) the heavier pigs are not utilizing their growth capacity as adequately in relation to the light pigs during the 10 to 25 pound period as they did during the 4 to 15 pound period, or (2) the light pigs have become more competent in their growth capacity during the 10 to 25 pound period than they were during the 4 to 15 pound period. The growth curves of the three birth-weight groups (Figure 1) indicate that from about ten pounds the growth rates of the three groups are equal. This is borne out by the analysis of variance between birth-weight groups for the period from 10 to 25 pounds.

That the light pigs are less efficient in their utilization of feed during early postnatal life and improve with age, thus making more rapid gains, would seem to be a plausible explanation for the changes in association between the light and heavy groups. It has been shown, however, that under laboratory conditions pigs of light birth weight utilize their feed as efficiently, from birth to five days of age, as those of heavier birth weight (19). Although supplemental feeding and added warmth were provided for pigs under conventional conditions in the present study, it appears that environmental conditions may still have been less adequate for the pigs of light birth weight than for their heavier litter mates during the early postnatal period. Newland's (33, p. 122) report that pigs of low birth weight are slower to reach a stage of adequate body temperature regulation again suggests that the pigs of light birth weight are at a disadvantage for as long as ten days after birth.

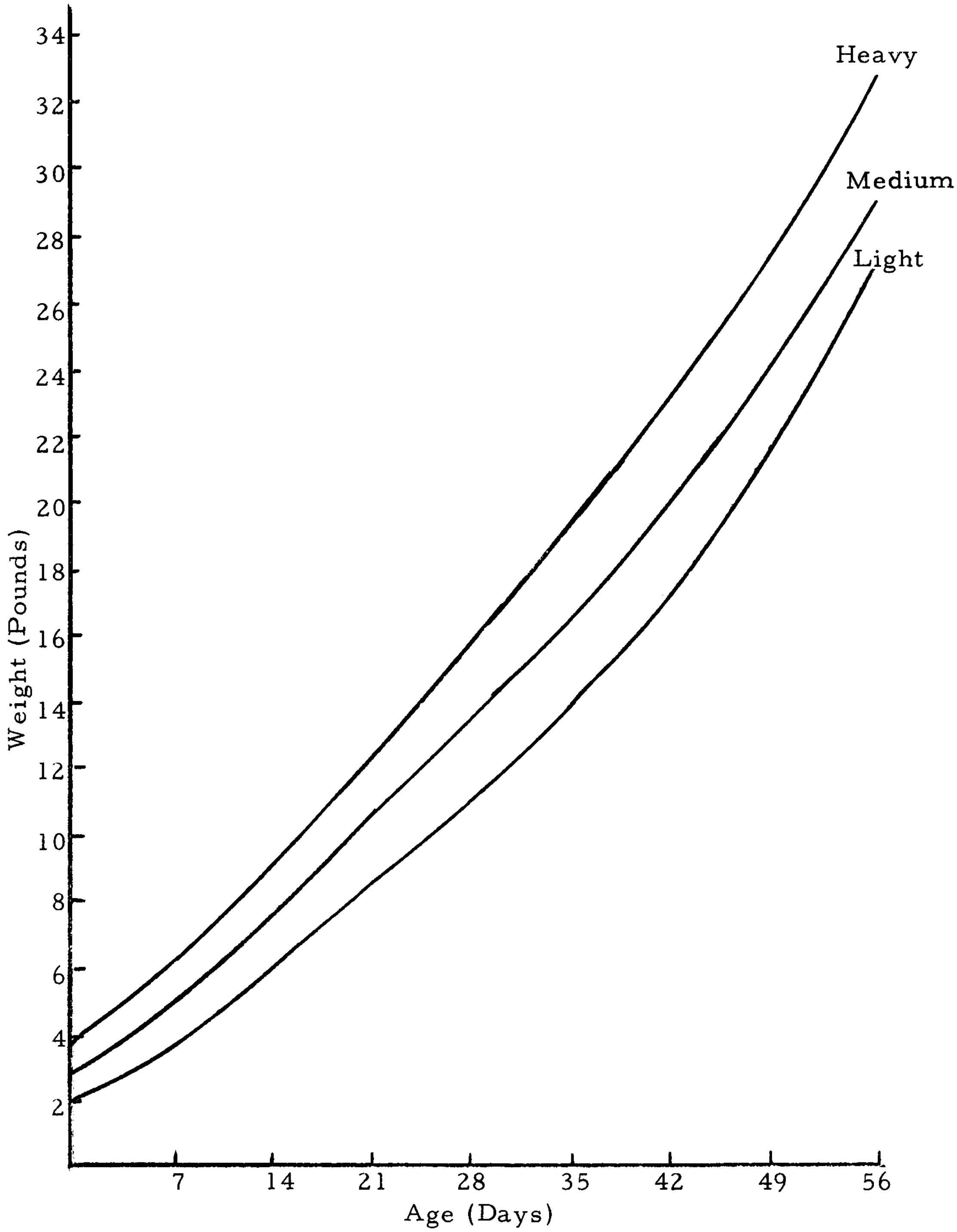

Figure 1. Growth curves from birth to 56 days of age for light-, medium- and heavy-birth-weight pigs raised under conventional conditions.

One explanation which might account for the changes in growth rate between the weight constant periods of 4 to 15 pounds and 10 to 25 pounds is that of relative adequacy of milk intake. Rose (39, p. 30) found that maximum milk flow occurs during the third to fourth week of lactation in the Oregon State University herd. During the third to fourth week in the present study, the light pigs weighed 8.7 to 11.0 pounds, whereas the heavy pigs weighed 12.8 to 16.0 pounds. If milk production was less than total intake desired at this time or later before reaching 25 pounds weight, the heavy pigs would be under more stringent conditions, while the light pigs might be drinking all the milk they could consume. It was also found by Rose that there is little association between birth weight and milk consumption in pigs between the ages of 14 and 42 days. It is possible, on the basis of these data, to postulate that the heavier pigs are comparatively limited in growth between 10 and 25 pounds weight by inadequate amounts of milk. Data are not available on the relative amounts of feed eaten by heavy and by light pigs during this weight-constant period, but it is generally recognized that additional feed intake is low at young ages, probably because adequate amounts of milk are available to satisfy the appetites of the young pigs. Smith (40), however, found that as the amount of available milk becomes limited, more creep feed is consumed. England and Rose (20) postulated that the increased gains made by heavier pigs may be due to increased creep feed consumption.

From a comparison of the periods from birth to 25 pounds and from 4 to 15 pounds with 4 to 25 pounds and 10 to 25 pounds it is clear that birth weight significantly influences neonatal growth ability under conventional conditions. It may be, then, that the light-birth-weight pigs are initially more severely handicapped by unfavorable environmental conditions but gradually become more adequately adjusted to the environment. They then reach a point at which their true capacity for growth can more readily be expressed.

The use of a laboratory environment, where the environmental variables of temperature, opportunity for feed consumption, and competition are essentially controlled should give all pigs, regardless of their weight at birth, the opportunity to grow at their maximum rate. Differences in growth, under this environment, should be caused mainly by genetic and not environmental differences. As indicated by the results obtained from Student's t tests (Table 11), there is no significant difference between the light and moderate group for net gain, milk consumption or feed efficiency when the test period is initiated at the same starting weight.

That no differences in gain occur between the two groups is in agreement with the results of the study with the pigs under conventional conditions.

The results of the laboratory test also indicate that on a weight constant basis the pigs of light birth weight consume as much milk as those of moderate birth weight, when given equal opportunity to do so. This shows not only that the pigs of light birth weight have the innate capacity to consume equal amounts of feed, but further that differences in capacity to ingest feed, or the willingness to do so, are not the causes of differences in preweaning growth rates found under conventional conditions. The data further indicate that pigs of light birth weight utilize their feed as efficiently as pigs of heavier birth weight. This is in accord with the results of England et al. (19), who found equal efficiency of feed utilization between light- and heavy-birth-weight pigs from birth to five days of age.

If the results of the laboratory test are compared with the results obtained under conventional conditions it can be concluded that light-birth-weight pigs have the innate ability to grow with as much rapidity and efficiency as the pigs of heavier birth weights from a specific initial weight, such as ten pounds. It might further be concluded that environmental factors such as regulation of body temperature and competition hamper the expression of the growth ability of the pigs of light birth weight during early postnatal life. It is evident that the main factor which causes differences in growth rate is weight per se and not a lack of ability to grow.

It was shown by Chapman and England (9) and Boaz and Elsley (5) that differences in capacity for postweaning growth rate can be obscured by the differences in weight at the initiation of tests. It was concluded by Chapman and England (9) that gains calculated on a weight-constant basis reflect genotypic differences more accurately than tests which are conducted on a time-constant basis. From the results found in the present study, it appears that on a preweaning basis it is also true that a weight-constant test period more accurately reflects the actual genotypic differences, especially when working with pigs of light birth weight.

It has been shown that the main cause of mortality in light-birth-weight pigs is their inability to cope with neonatal environment (33, p. 121; 36, p. 54). It has also been reported that an alteration in the environment which facilitates the growth of these pigs increases the numbers raised (20).

Heritability estimates for birth weight (25) and repeatability estimates for within litter variation of birth weights (8, p. 54), indicate that the majority of the variation in birth weights is due to factors which are lowly heritable. Studies on the physiological nature of variations of birth weights (1; 7, p. 86; 38, p. 32; 43) support these indications, as they have shown that variations in birth weight are due mainly to the effects of litter size, crowding, position in the uterus, and, in turn, assumed differences in the nutrition of the fetus. It would seem reasonable, then, that pigs of light birth weight are smaller at birth because of environmental conditions imposed *in utero*, and that these conditions impose a restriction upon the ability of the pigs of light birth weights to adjust at birth to a new environment. From this it can be concluded that the restriction of growth during the early life of pigs of light birth weight is due to size *per se* and not to genetic inferiority.

If these conclusions are valid then production techniques should be adopted which give the pigs of light birth weight a more adequate environment. With present knowledge, it is unlikely that changes in management procedures could alter prenatal environment enough to increase birth weight while holding litter size constant. However, an increase in litter size at weaning of 20 percent can be brought about by using improved management techniques (19). The use of supplemental milk feeding and supplemental heat also give the light or weak pigs assistance during early life which may reduce the length of time required before full utilization of growth ability occurs.

An increase in numbers weaned per litter is not only of economic importance but also of genetic importance. It is known that increased selection efficiency can result when larger numbers are used from which to select. Thus, an increase in litter size of 20 percent at weaning might increase selection efficiency by making available larger numbers from which to select. Pigs of light birth weight, as the results of this study indicate, have the innate ability to be competitive with regard to feasible use in a selection program.

Inspection of the data used by Chapman and England (9), for example, shows that of the 20 gilts with highest average daily postweaning gains on an age to weight basis, only 13 would have been selected on the basis of highest average daily gain on a weight-constant basis.

Finally, the results found in this study support the postulation of England and Rose (20), namely that pigs of light birth weight cause no economic disadvantage in commercial production other than the extra initial care and the time required to reach market weight.

SUMMARY AND CONCLUSIONS

1. A significant ($P < .01$) negative correlation was found for birth weight with the number of days required to grow from 4 to 15 pounds. A significant difference ($P < .05$) occurred between pigs of light and heavy birth weights for rate of gain during this weight constant period.

2. A significant ($P < .01$) positive correlation was found for birth weight with average daily gain from birth to 25 pounds. A significant difference ($P < .05$) was found between the light and heavy groups for average daily gain during this period. The conclusion was drawn that environmental conditions for pigs of light birth weights are inadequate during the neonatal period of life, resulting in a decreased rate of gain during this period and thus during the total period from birth to 25 pounds.

3. No significant difference was found between the three birth-weight groups for the number of days required to grow from 10 to 25 pounds or from 4 to 25 pounds. It was concluded that a change in the relative growth rates had occurred for the light and heavy groups between the 4 to 15 pound and the 10 to 25 pound periods. Two postulations are given to account for this change:

a. The heavier pigs do not grow relatively as rapidly during the 10-to-25 pound period, probably because the amount of milk required by the heavier pigs is becoming unavailable.

b. The pigs of light birth weight become more competent in their growth capacity during the 10-to-25 pound period, mainly due to the stabilization of body temperature with resulting adaptation to existing environmental conditions.

4. No significant difference was found between pigs of light and moderate birth weights raised under laboratory conditions for net gain, milk consumption or feed efficiency. It is concluded that:

a. On a weight-constant basis, pigs of light birth weight have the innate capacity to grow as rapidly as pigs of heavier birth weights.

b. Given equal opportunity, pigs of light birth weight consume as much milk as pigs of heavier birth weight.

c. On a weight-constant basis, pigs of light birth weight utilize their feed as efficiently as pigs of heavier birth weights.

d. Under laboratory conditions, with the environmental factors of temperature, opportunity for food consumption, and competition controlled, there is no difference in performance between light and heavy pigs when measured on a weight constant basis.

5. From a comparison of the results of the test of pigs under conventional conditions with that of pigs under laboratory conditions, it was concluded that the use of pigs of light birth weight in a commercial program is economically sound and that their use as part of the breeding herd could increase the number of animals from which to select, which might, in turn, increase the efficiency of selection.

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