DECLARATION

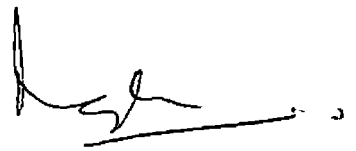
I hereby declare that this thesis entitled "EFFECT OF WEIGHT AT WEANING AND PLANE OF FEEDING ON THE ONSET OF PUBERTY IN GILTS" is a bonafide record of research work and that the thesis has not previously formed the basis for the award to me of any degree, diploma, associateship, fellowship or other similar title of any other University or Society.

Mannuthy,
24-9-1993.

Lalnuntluangi Hmar

CERTIFICATE

Certified that this thesis entitled **"EFFECT OF WEIGHT AT WEANING AND PLANE OF FEEDING ON THE ONSET OF PUBERTY IN GILTS"** is a record of research work done independently by Smt. Lalnuntluangi Hmar under my guidance and supervision and that it has not previously formed the basis for the award of any degree, fellowship or associateship to her.



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We, the undersigned members of the Advisory Committee of Smt. Lalnuntluangi Hmar, a candidate for the degree of Master of Veterinary Science in Livestock Production Management, agree that the thesis entitled **"EFFECT OF WEIGHT AT WEANING AND PLANE OF FEEDING ON THE ONSET OF PUBERTY IN GILTS "** may be submitted by Smt. Lalnuntluangi Hmar in partial fulfilment of the requirement for the degree.

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Lalnuntluangi Hmar

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Dedicated to
my beloved parents

CONTENTS

Introduction

1. INTRODUCTION

Livestock production has long been man's primary occupation in most countries of the world. With today's increasing population and its ever increasing consumption of meat, swine production is assuming a leading role in agricultural income.

With increase in human population India is facing acute shortage of animal protein. To overcome the low availability and large requirement of animal protein, it is essential to make all efforts to improve and enhance the availability of meat producing animals.

From the point of efficient production of meat, pigs excel other livestock and play a vital role in the economy of the country as they are good converters of feed into meat for human consumption. They are tolerant to wide variety of feed and can make full and efficient use of the farm and other products which would otherwise be wasted. They are prolific and can be raised in small areas either in close confinement or on pasture.

In tropical countries, pig production has a bright potential, as it can be successfully and economically

the ability of the sow to reproduce and raise her young efficiently at the estimated cost and in short duration. A sow can easily produce per year two litters of 10 marketable pigs which allows swine rearing a profitable business requiring about as short a time to get into business as to get out.

The success and efficiency of pig farming depends upon the reproductive performance of the pigs. The stage at which gilts is mated for the first time can have important implications on the efficiency of its lifetime production. For the success of reproductive performance with larger litter size, gilts should attain at least third oestrus (Bundy et al., 1976). Mating at a lighter and younger age has been practiced in order to improve the total efficiency of the breeding female. The success of such a move depends on the attainment of puberty at an early age together with satisfactory ovulation, conception and embryo survival (Hughes and Cole, 1975).

Puberty in a simple sense may be defined as the phase which links immaturity and maturity recognised by

the occurrence of first oestrus (Hughes and Varley, 1980). It is the stage at which the female becomes capable of reproducing and normally occurs at about six to seven months of age (Hafez, 1987).

For rearing replacement stock, it is both desirable and necessary to induce early puberty attainment in the gilts as it is costly to keep non-productive animals until the initiation of the first pregnancy. Financial success is therefore largely dependent upon the onset of puberty and their subsequent reproductive performance.

In swine production, cost of feed normally represents 75 per cent of the total cost of production. Consequently, the profit from the swine enterprise is directly affected by the extent to which efficient and economical use of feeds has been made.

Feeding can undoubtedly influence the age at puberty and is related to adequate energy intake and the attainment of sufficient body weight. The body weight at weaning is an important factor and is expected to influence subsequent performance in various ways such as growth rate or delaying sexual maturity. Early onset of sexual maturity provides economic advantages through increased lifetime reproductive rate. So, it is important

to the farmers to understand the optimum body weight of pigs at weaning intended for breeding and, the plane and level of feeding from weaning till they attain puberty, so as to minimise the cost of maintenance and maximise the net return from the pigs.

In the light of the foregoing resume the present study was undertaken with the following set objectives:

1. To find the optimum plane of feeding level of gilts from weaning till onset of puberty.
2. To find the influence of variation in body weight at weaning on the onset of puberty in gilts.

Review of Literature

2. REVIEW OF LITERATURE

Puberty is an economically important criterion as it is related to the age at breeding and the consequent lifetime production. From a practical point of view, puberty attainment represents the onset of reproductive capability, since the first behavioural oestrus normally coincides with the pubertal ovulation. Puberty is basically the result of a gradual adjustment between increasing gonadotrophic activity and the ability of the gonads to assume steroidogenesis and gametogenesis.

2.1 Age at puberty

The age at puberty is influenced by various factors such as breed and genotype of the gilt, nutritional status and the climatic environment.

Dyck (1971) reported an average age at puberty as 197.5 $\pm$ 1.8 days, within a range of 141 to 254 days in 132 gilts with an average oestrous cycle length of 21.0 $\pm$ 0.2 days and 21.7 $\pm$ 0.1 days in Yorkshire and Lacombe breeds of pigs respectively.

For local Chinese and Landrace gilts Mahendranathan and Mellish (1975) observed the first

oestrus at 162.2 and 241.9 days respectively.

While Reuther et al. (1976) reported the average age at puberty as 246 days in 1085 gilts which were examined daily for signs of oestrus from 100 days of age.

Friend (1977 a) reported that a reduced feed intake and/or a suspected deterioration of a high fat diet delayed the onset of puberty by 21 days in prepuberal gilts between 156 and 175 days of age.

Einarsson et al. (1978) observed the onset of first oestrus from 5 months to 280 days of age in 44 Swedish cross-bred gilts, and found that 88.6 per cent of gilts exhibited oestrus and age at first oestrus at the average age of 233 days.

Marayama et al. (1978) found that 90 per cent of gilts had reached puberty by 250 days of age in which the first oestrus was observed from 170 day old gilts.

Hutchens et al. (1979) reported a significant effect of breed of dam on the onset of puberty. He has further stated that in gilts from Spot, Duroc, Landrace and Yorkshire dams, age at puberty averaged 188.8, 189.8, 191.9 and 197.6 days respectively. It was also found that cross-bred gilts were 6.3 days younger at puberty than pure-bred.

Braune and Schlegel (1981) reported that age at puberty averaged 235 days (218 to 251 days).

Fan et al. (1982) reported an average age at puberty 64 days (40-86 days) with oestrus period 7 days (1-13 days), oestrous cycle length averaging 17 days (8-32 days) in gilts of Erhualian pigs.

Anderson and Karlbom (1982) studied 90 Swedish Landrace x Swedish Large White gilts from approximately four months of age and daily oestrus checking was done. Age at first oestrus averaged 185 days (151-236 days). Gilts born in January- March tended to be slightly older at first oestrus than those born in August- October. Oestrous cycle from 11 gilts during their first 6 oestrous cycle averaged 21 days. Length of pro-oestrus averaged 48 hours during the first two oestrus periods vs. 24 hours for later periods, whereas some females showed no signs of pro-oestrus from the third oestrus onwards.

Hutchens et al. (1982) found that the cross-breds were significantly younger (by 7.6 days) than pure-breds at first oestrus which were detected by a teaser boar. The percentage of gilts not showing oestrus was 7.8 in cross-bred vs. 16.4 in pure-bred.

Mohanty and Nayak (1966) studied the reproductive performance in 60 Large White (LW) and 40 LW x local. Age at puberty in 35 and 25 gilts averaged 192.4 and 237.8 days respectively. Oestrous cycle length was 22.80 ±0.19 and 23.43 ± 0.32 days , while the duration of oestrus averaged 72.4 and 82.3 hours respectively.

On an average workers reported that gilts attained puberty between 140 and 255 days of age.

2.2 Weight at puberty

The body weight is an important factor for the attainment of puberty in gilts, and it appears that a lower limit of body weight exists below which puberty will not be attained.

Mahendranathan and Mellish (1975) reported a highly significant difference in body weight at first oestrus of local Chinese and Landrace gilts. The weight at first oestrus were 48.7 and 84.2 kg respectively.

Einarsson et al. (1978) reported the average body weight at first oestrus as 104 kg in 44 Swedish cross-bred gilts and concluded that the time of first oestrus was correlated with age and body weight of gilts but could not ascertain which of these two factors was the most important one.

Marayama et al. (1978) investigated the onset of first oestrus in four different breeds and cross-bred gilts between 150 and 250 days of age. Oestrus was first observed at approximately 90 kg body weight and found that 90 per cent of gilts had reached puberty by 130 kg body weight.

Hutchens et al. (1979) collected data on 463 gilts representing four breeds and their two breed crosses to study the effect of breed of sire on the weight at puberty. Landrace-sired gilts were the lightest at puberty and Duroc-sired gilts the heaviest (206.6 vs. 218.8 lb). Spring-born gilts were 7.3 lb heavier than autumn-born gilts.

Braune and Schlegel (1981) reported significant difference between progeny groups of 173 gilts. The gilts were tested daily for oestrus from six months of age, and were slaughtered at 263 days. By the time of slaughter, 61.8 per cent had come to oestrus at an average weight of 114 kg (105.3 to 120.6 kg), with a daily gain of 485 g (458 to 497 g).

Anderson and Karlbom (1982) observed first oestrus at an average body weight of 98 kg (65-113 kg) in 90 Swedish Landrace x Swedish Large White gilts which were subjected to periodic blood hormone check, ovarian

laporoscopy and daily oestrus check.

Mohanty and Nayak (1986) reported an average live weight of 37.3 and 42.7 kg in Large White (LW) and Large White x local respectively in hot humid climate of Orissa.

Krieter and Kalm (1990) have done experiments on 33 Large White and Pietrain pigs for 40 weeks, to study body weight and food intake as functions of age. Large White had a higher feed intake, heavier at sexual maturity, had a slightly greater gross feed efficiency, a lower feed consumption rate and reached sexual maturity later and heavier than Pietrain females. It was concluded that animals that grew rapidly during the early growing period matured earlier and had a smaller mature size than slow growing pigs.

2.3 Plane of feeding

Live weight and rate of growth are interrelated with the nutrient supply to the animal and, thus, expected that both plane of feeding and the composition of the diet influence the growth and puberty attainment in the female.

2.3.1 On growth

The growth rate of gilts can be considerably altered by nutritional status and, is thought to have an influence <u>per se</u> on puberty attainment.

In an effort to explain growth rate influenced puberty attainment Phillips and Zeller (1943) have reported that faster growing animals mature earlier because they have a higher level of pituitary activity.

Oyeleke et al. (1985) suggested that for a humid climate, the dietary protein requirement for pigs between 9 and 60 kg body weight was 16-20 per cent but for economic reasons 18 per cent protein may be optimum. Their work revealed that increasing dietary protein from 14 to 16 per cent increased growth rate and beyond this level caused decrease in feed intake and growth.

Kuan et al. (1986) reported that pigs given a high energy diet grew faster with a better feed conversion ratio, than those given the low-energy diet. The growth rate was faster and feed conversion efficiency improved linearly with increasing protein:energy ratio.

Zhang et al. (1986) reported that increasing the energy concentration reduced feed intake and improved live weight gain and food:gain ratio. Increase in gain at higher protein concentration was seen only at a lower energy concentration in pigs weaned at three weeks of age.

Baran (1991) showed that when cross-bred pigs were fed at 15 or 30 per cent below recommended energy and

protein level, the average daily body weight gain reduced and cost of gain increased than those fed with diet reduced only in energy level.

Beltranena (1991) reported a quadratic negative relationship between lifetime growth rate and age and, indicated that age at puberty was minimum at a growth rate of 600 g per day. Thereafter, age at puberty became independent of, or positively related to lifetime growth rate. Gilts with higher growth rate were found heavier and fatter at puberty.

2.3.2 On puberty

Hafez (1960) reported a significant difference between the high and low-plane of feeding in age and weight at puberty of Palouse gilts (195 vs. 186 days and 225 vs. 152 lb).

The gilts maintained on high-plane of nutrition were found to be significantly lighter (106 vs. 118 kg) and younger (246 vs. 280 days) at puberty than those fed a control diet (Salmon-Legagneur, 1971).

Holness (1973) reported that when fed at levels equivalent to 100, 75 or 50 per cent of the feed requirement to indigenous gilts, age at puberty averaged 116, 126 and 127 days respectively.

Duee and Etienne (1974) stated that gilts fed ad libitum from a live weight of 55 kg reached puberty earlier and were heavier than those fed 45 per cent of ad libitum feeding.

When Russian Large White gilts were fed with a standard diet or 24 per cent lower or higher than standard, Tsiganchuk (1976) observed first oestrus at 188.4, 202.0 and 191.3 days, with the average body weight of 73.3, 57.9 and 81.2 kg, oestrous cycle of 19.2, 20.4 and 19.8 days and oestrus duration 56.3, 54.0 and 53.8 hour respectively.

According to Friend (1976) age at puberty range from 155-228 days. Gilts receiving ad libitum feed reached puberty 20 days earlier than those limit fed gilts. The body weight at puberty reflected the differences in daily gain and those ad libitum fed gilts gained fastest and were the heaviest at puberty.

When gilts were fed at a high, average and low level from 25 kg live weight, average age at puberty was reported as 208, 207 and 220 days (Schilling and Schroder, 1978).

Friend (1981) reported that gilts fed ad libitum were younger and heavier at puberty (159 vs. 170 days and

97 vs. 92 kg) than those limit-fed gilts.

Crnojevic et al. (1984) reported that when Swedish Landrace gilts were fed at levels equivalent to 100, 90 or 80 per cent of the feed requirement from 60 kg body weight, age at puberty averaged 101, 98 and 94 days. Where as Lo et al. (1985) reported that age at puberty averaged 166.2, 167.3 and 174.3 days in Landrace litters fed at levels equivalent to 100, 90 or 75 per cent The body weight at puberty averaged 88.8, 89.2 and 80.3 kg respectively.

On restricting the diet to 85 per cent of free-choice, Lunen and Aherne (1987) found that the age at puberty was delayed, but weight at puberty was unaffected by plane of feeding.

Early maturity was observed by Shneider and Zelenin (1989) when gilts were fed at an increased level from four to nine months of age.

According to Ogle and Dalin (1989), gilts fed on a high-level diet were heavier at puberty than those fed low-level (55 per cent) diet. The pigs with heavy initial body weight fed on high-level diet reached sexual maturity 26.4 days earlier than the corresponding females fed on low-level diet.

Restriction of feed intake to 50 per cent of ad libitum delayed puberty in gilts by 6 days, and have lighter body weight (Newton and Mahan, 1992).

2.4 Dietary energy and onset of puberty

On restricting energy intake Goode et al. (1961) showed that there was reduction in weight (130.5 vs. 151.4 kg) at puberty and delayed the onset of puberty (296 vs. 268 days) in Duroc gilts.

Sorensen et al. (1961) reported that gilts fed high-energy diet reached puberty two days earlier (208 vs. 210 days) and weighed 26 lb more (187 vs. 161 lb) than those fed low-energy diet.

The studies conducted by O'Bannon et al. (1966) on cross-bred indicated that gilts fed on high-energy diet attained puberty 13 days earlier (194 vs. 207 days) and were 21 kg heavier (102 vs. 81 kg) than those fed low-energy diet.

Holness (1973) reported that energy level had no apparent effect on the live weight and age at sexual maturity in indigenous (South African) gilts.

According to Etienne and Legault (1974), higher dietary energy level tended to delay the onset of puberty in Pietrain breed.

Restriction of energy intake to 85 per cent of free-choice from 45 to 90 kg in Lacombe gilts increased the age to reach 90kg by approximately 7 days, but decreased the age at puberty by 9 days (Aherne et al., 1976).

The effect of dietary energy and protein on age and weight at puberty was investigated by Friend (1977 b) and reported that age at puberty averaged 168 days (127-212 days), which was affected neither by energy nor protein supplementation. There was significant increase in body weight by the addition of energy, but not protein to the diet. Increasing the energy and protein content significantly increase the rate of weight gain. The efficiency of calorie and protein utilisation did not differ among levels of intake, but pointed out a need to increase both dietary energy and protein intake to maintain conversion efficiency.

Pastavalau and Shkunkova (1981) reported a mean onset of oestrus at 189.9, 185.4, 182.0, 191.1 and 202.5 days in Large White gilts given a mixed feed containing crude protein 302, 294, 288, 275 or 246 g, metabolizable energy 6300, 6086, 6096, 6268 or 6457 kcal and protein:energy ratio 120, 120, 118, 110 or 95 during the pre-oestrus period from 3 to 6 months. The oestrous cycle

length was recorded as 22.1, 21.4, 22.3, 22.9 and 23.2 days respectively.

According to Hartog and Noordewier (1985) the age at puberty in Dutch Landrace gilts decreased and weight increased with increasing metabolizable energy content of the diet, but spontaneous oestrus was not significantly affected by different energy intake.

On feeding isonitrogenous diets at 80, 100, or 120 per cent of recommended energy level, Koczanowski et al. (1993) reported the first oestrus at 198, 190 and 183 days respectively.

2.5 Dietary protein level and onset of puberty

According to Holness (1973) dietary protein level had a significant effect on live weight and age at sexual maturity in gilts.

On feeding a diet containing 10 per cent or 14 per cent protein, Cunningham et al. (1974) found that gilts fed high-protein reached puberty 18.7 days earlier than those fed a low-protein diet.

Jones and Maxwell (1974) studied the effects of three levels of crude protein on the reproductive performance of Yorkshire gilts. Gilts were fed 178, 317 or 431 g of CP daily from 146 to 180 days of age, then

reduced to 143, 254 or 345 g per day. Age at first, second and third oestrus tended to decrease with additional protein intake but the effects were not significant. The incidence of anoestrous was found more in gilts with the two lower protein levels.

Wahlstrom and Libal (1977) reported that gilts fed on 14 per cent protein diet gained faster during the development period and were heavier and younger at breeding than those fed 10 per cent protein diet.

Duee (1978) observed puberty at 262.8, 262.6 and 254.7 days and weight averaging 100.9, 121.4 and 116.4kg respectively in Large White gilts which were fed diets containing 11.5 per cent protein with 0.42 per cent or 0.62 per cent lysine or 17.5 per cent protein with 0.86 per cent lysine.

Gilts fed diets containing 16, 12 or 16 per cent CP from 28 to 60 kg and thereafter reducing the protein content to 14, 14 or 10 per cent upto puberty did not significantly affect on the age at puberty (Duee et al. 1981).

Fuchs (1984) reported the age at first oestrus as 180, 190 and 203 days and daily gain of 645, 582 and 474 g in gilts fed on diets containing 19.5, 17.3 and 13.5 per

cent CP respectively from 20 to about 90 kg live weight.

Podletskaya et al. (1988) stated that an increase in protein level in the diet (dry matter basis) to 20.2 per cent increased the growth rate in Rissian Large White gilts by 24 per cent but decreased the age at sexual maturity by 20 days. Gilts fed with 13.5 per cent protein decreased growth rate by 7.2 per cent and sexual maturity was delayed by 13 days.

On feeding low-protein diet, Rydhmer et al. (1990) observed that the size of the litter in which the gilts were born was negatively related to age at first ovulation.

Eliasson and Rydhmer (1991) reported a mean age at first oestrus as 212 ± 20 days at mean body weight of 118 ± 14 kg in 414 Swedish Yorkshire fed on high or low-protein diet. On low-protein diet, the size of the litter in which gilts were born affected the age at sexual maturity.

2.6 Weaning weight and age

The weight and age of pigs at weaning are expected to influence subsequent performance.

2.6.1 On growth

According to Fowler and Boaz (1963) light-weaners

took longer time to reach 130 lb live weight than heavy weaners on both generous and restricted levels of feeding.

On the contrary, Csire (1965) did not find any appreciable differences in weight gain and feed efficiency between groups with a low, average or high body weight at weaning.

When the weaning weight of piglets were increased, a linear increase on daily gain and shorter duration of fattening was reported by Vasilev et al. (1972).

Antonets' (1979) reported that piglets weaned at 30 days of age were heavier at 60 days of age than those weaned at 21 or 60 days and found that body weight at 2 months was significantly correlated with birth weight and weaning age.

From the observation in two trials involving the effect of initial weaning weight and crude protein, Rodriguez et al. (1982) came to the conclusion that initially heavier pigs ate more feed and gained more weight than those light-weaners. There was linear increase in average daily gain with increasing CP content of the diet.

McConnell et al. (1987) observed a slower gain of the lighter weaned pigs for four weeks post-weaning than

heavy-weaned pigs. The growth curves for light and heavy-weaned pigs were found to remain parallel throughout the four weeks nursery period indicating that small pigs were not making compensatory gain.

The effect of nutrient density on growth performance of pigs weaned at different weight was investigated by Yen et al. (1989) and came to the conclusion that heavy weaned piglets had greater weight gain due to higher daily intake of digestible energy and lysine.

2.6.2 On puberty

The effect of age and live weight of piglets at weaning on their reproductive performance was investigated by Gajic (1971). He found that piglets weaned at 35 to 56 days of age resulted in higher slaughter weight and lower feed consumption per kg gain than those weaned at 21 to 35 days of age. Age at weaning was found to have no correlation with age at first oestrus.

Heyde and Lievens (1985) did not find any significant effect of age at weaning, piglet's weight at 12 days, birth weight and litter size on their subsequent reproductive performance. However, they suggested that female reproductive performance improved by reducing the size of the litter in which they were reared and by early

weaning.

2.7 Symptoms and behavioural manifestation at puberty

Hafez (1960) reported a lower incidence of silent heat in gilts fed low-plane (70 per cent of full-feeding) than in high-plane of feeding.

According to Signoret (1970), early deprivation of social contact had no effect on the two major components of female sexual behaviour such as attraction by the male and the immobility reaction. The result suggested that the female sexual behaviour of the pig was largely a genetic function.

In virgin gilts duration of oestrus ranged from 18 to 48 hour (Danilov, 1972).

Roshevskii (1974) conducted an oestrus detection in gilts by different method and showed that 78.0 per cent, 76.1 per cent and 70.4 per cent was detected by teaser boar, visual assessment by attendants and standing reflex respectively.

From the observation on the first oestrous cycle of 52 Dutch Landrace, Bedrijfsontwikkeling (1977) showed that duration of oestrus averaged 40 hour (15-75 hour). In 30 per cent of female, oestrus could not be detected visually, 30 per cent of females in oestrus did not show

standing reflex, but one-third of these females responded to boar odour; 20 per cent of female responded only to the boar.

Sommer (1980) stated that the female housed individually showed more contact-seeking activity and stronger reaction to the observer during oestrus than group-housed females, although a typical oestrous behaviour such as mounting was possible only in group.

The onset of oestrus was observed at 06:00, 12:00, 18:00 and 24:00 hour from day 16 of the first oestrous cycle in cross-bred gilts by Clark et al. (1986) and found that 55 per cent of the gilts showed onset of oestrus by 06:00 hour, none of them showed oestrus from 06:00 to 12:00 hour whereas 24 per cent and 21 per cent had shown onset of oestrus by 18:00 and 24:00 hour respectively.

Eliasson (1991) reported that out of 547 Swedish Yorkshire gilts, 481 reached puberty during the experimental period from 160 to 260 days of age in the presence of boar. Of these 77 gilts did not show standing oestrus at first ovulation but showed red and swollen vulva. Gilts with low backfat thickness had less intense and a shorter period of reddening and swelling of vulva at puberty than gilts with high backfat thickness. Growth rate and backfat thickness did not influence oestrous

symptoms at puberty. Gilts which attained puberty earlier showed more intense and longer duration of reddening and swelling of the vulva than those which attained puberty at later age.

Eliasson and Rydhmer (1991) observed a longer first pro-oestrus than second or third, but a shorter first oestrus than the second.

Newton and Mahan (1992) stated that gilts showing oestrual bahaviour was lowest as feed intake increased and were difficult to detect the oestrus.

Materials and Methods

MATERIALS AND METHODS

Thirty six Large White Yorkshire weanling female pigs belonging to University Pig Breeding Farm, Kerala Agricultural University, Mannuthy, averaging about 8kg (light weaners) and 12kg (heavy weaners) body weight were randomly grouped into two of 18 each respectively. Pigs in each group were assigned at random to three treatment groups of six pigs and were housed separately in lots of three each, so that each treatment was repeated to have two observations.

The pigs in both the groups were maintained on three planes of feeding with respect to crude protein (CP) and digestible energy (DE) as follows:

i Treatment group I- A high plane (HP) of 10% increase of CP and DE with reference to NRC level

ii Treatment group II- NRC recommended level of nutrient in regard to CP and DE (NRC, 1979) (NRC)

iii Treatment group III- A low plane (LP) of 10% decrease of CP and DE with reference to NRC level.

Table 3.I. CP and DE content of the Experimental Diets

Treatment group	Weight group	CP%	DE kcal/kg
I	Weaning to 20 kg	19.8	3850
	21 kg to 35 kg	17.6	3630
	36 kg to Puberty	15.4	3630
II	Weaning to 20 kg	18.0	3500
	21 kg to 35 kg	16.0	3300
	36 kg to Puberty	14.0	3300
III	Weaning to 20 kg	16.2	3150
	21 kg to 35 kg	14.4	2970
	36 kg to Puberty	12.6	2970

The rations to pigs were computed using the following ingredients:

Ingredients	Cost/ 100kg (Rs.)
1. Groundnut cake (GNC)	549.00
2. Dried unsalted fish	648.00

3.	Yellow maize	491.00
4.	Wheat bran	383.00
5.	Rice polish	381.00
6.	Rice bran	251.00
7.	Beef tallow	2300.00
8.	common salt	100.00
9.	Mineral mixture	357.00
10.	Vitamin AB D (Rovimix) 2 3	849.00/kg

Pigs were housed in 12 identical cement concrete floored open styes each having a net roof area of 6.1 m^2 and asbestos roof. Feed was provided to the pigs in built-in feed trough twice daily at 09:00 hour and 14:30 hour, allowing them to consume as much as they could within a period of one hour. Drinking water was provided at all times in the pen. The feed intake was recorded daily on all days till the experiment was concluded.

The pens and pigs were cleaned and washed in the morning and evening before feeding. Butox* (0.002%) was sprayed once in a month on pigs and premises to prevent ectoparasitic infection. The pigs were dewormed at the

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* Deltamethrin 1.25% (Hoechst India Ltd., Bombay)

commencement of the experiment using Fenbezol** and repeated after a month. One ml of Imferon*** (Iron Dextran) was given intramuscularly at weaning to prevent piglet anaemia.

Fortnightly body weight of pigs were recorded using platform balance having a built-in cage till one month after confirming the puberty.

The behaviour of the pigs were studied for a duration of one hour each at 07:00 hour and 16:00hour. The onset of puberty in the pigs were recorded based on the behavioural manifestation and from the nature of external symptoms of heat and further confirmed with the use of a boar. Pigs were maintained one more month after confirming puberty to study the oestrous cycle. The oestrus period was recorded based on the duration of gilts sexual receptivity to the boar.

** Fenbendazole 25% (Ranbaxy Labs Ltd., Secunderabad)

*** Imferon 50 mg iron per ml (Rallis India Ltd., Bombay)

The gilts were scored for their behavioural patterns during oestrus as described below:

Table 3.2 Oestrus Behaviour of Gilts.

Sl. No.	Description	Score +ve	Score -ve
1.	Restlessness, excitement, swollen, moist vulva and mucus discharge	1	0
2.	Oestrus grunt and searching for boar	1	0
3.	Mounting on other pigs	1	0
4.	Sniffing and fondling of boar genitalia	1	0
5.	Typical mating stance on the sight of boar and allowed to be mounted.	1	0

Data pertaining to puberty were taken only upto 10th in heavy weaners and upto 14th fortnight in light weaners as the pigs attained puberty by that period respectively.

The following observations were recorded:

1. Fortnightly body weight of the pigs
2. Age at puberty
3. Weight at puberty

4. The length of oestrous cycle and, oestrous period
5. Daily feed consumption within one hour both in the morning and evening.

The cost of production from weaning till puberty was calculated in all the treatment groups with assumptions that feed represented 75% of the total cost of production.

The data collected during the course of the study were statistically analysed as per the method described by Snedecor and Cochran (1967).

Results

4. RESULTS

4.1. Body weight of pigs

4.1.1 Heavy weaners

The average fortnightly body weight of heavy weaner pigs of the three treatments are presented in Table 4.1. and Fig. 4.1. The fortnightly weight of treatment I has shown an increase from 12.00 ± 0.585 to 48.13± 0.815 kg from weaning to 10th fortnight. This group has shown a total gain of 36.13 kg during the period of 10 fortnights. The average body weight of treatment II has shown an increase from 12.00 ± 0.429 to 52.83 ± 5.548 kg giving a total gain of 40.83 kg upto 10th fortnight. The third treatment gives a total gain of 38.59 kg(12.08 ± 0.449 to 50.67 ± 3.927 kg).

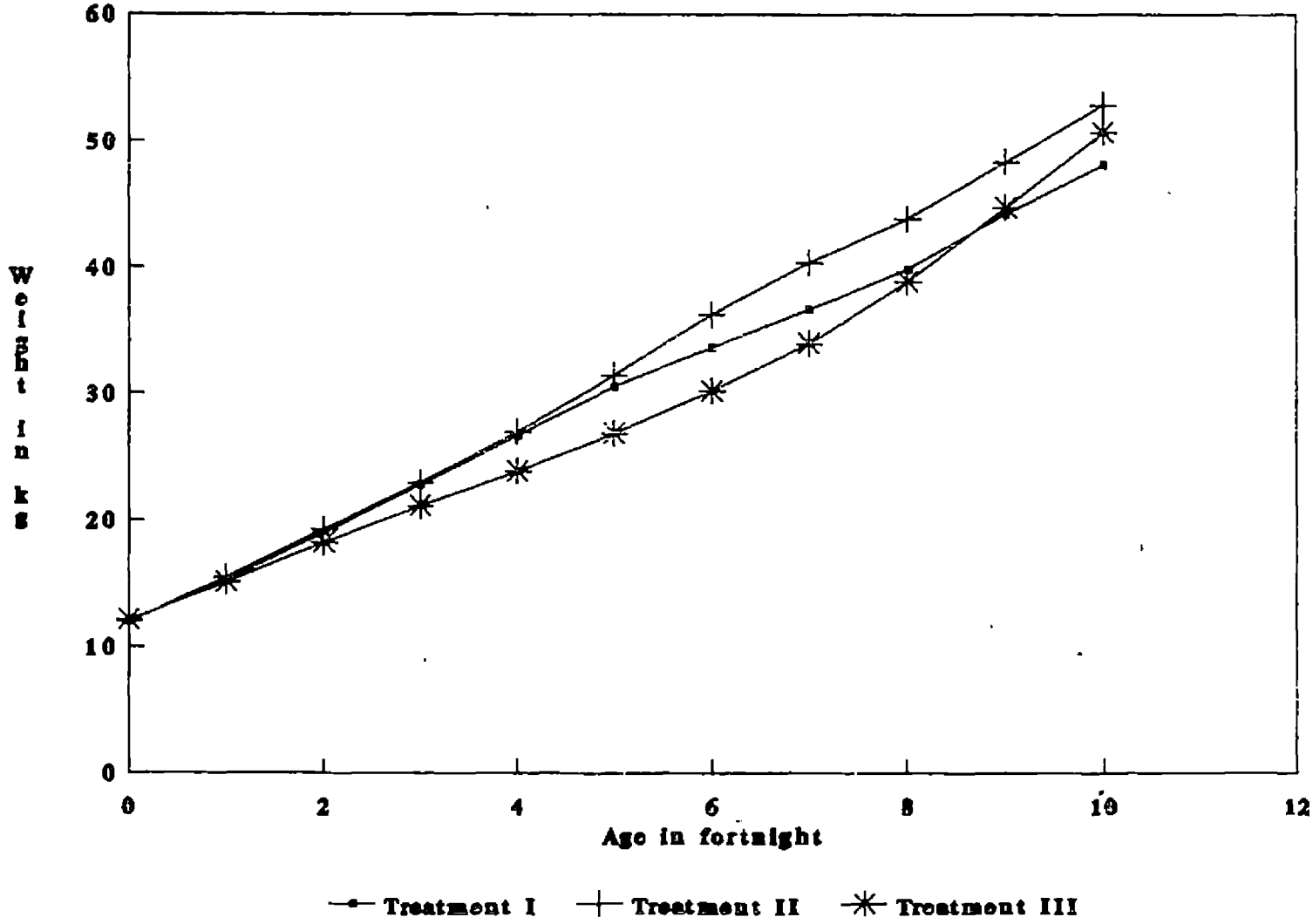
The maximum weight gain was noticed in the NRC treatment (40.83 kg) followed by third treatment (38.59 kg). The lowest body weight gain was noticed in the high-plane of heavy weaners (36.13 kg). The gain in weight showed a decreasing tendency in the case of heavy weaners as the energy level was increased. The results when analysed statistically showed that variation of average fortnightly body weight of pigs due to plane of feeding was not significant.

Table 4.1. Fortnightly body weight of Heavy Weaners (kg)

Fortnight	Treatment I [HP]	II [NRC]	III [LP]	f-value	
Weaning weight	12.00±0.585	12.00±0.429	12.08±0.449	-	NS
1	15.25±1.410	15.50±0.772	15.08±0.616	-	NS
2	19.00±1.630	19.25±1.200	18.17±0.955	0.1929	NS
3	22.75±1.680	22.92±1.800	21.08±1.396	0.3296	NS
4	26.63±1.875	26.92±2.559	23.83±1.751	0.5359	NS
5	30.50±1.885	31.42±3.099	26.83±2.184	0.7771	NS
6	33.63±1.865	36.25±3.768	30.17±2.731	0.8684	NS
7	36.63±1.670	40.33±4.503	33.92±3.159	0.7122	NS
8	39.88±1.305	43.83±4.915	38.83±3.569	0.3906	NS
9	44.25±0.895	48.33±5.368	44.75±3.609	0.2323	NS
10	48.13±0.815	52.83±5.548	50.67±3.927	0.2076	NS
Total gain	36.13	40.83	38.59		

NS Non-significant

FIG. 4.1.FORTNIGHTLY BODY WEIGHT OF HEAVY WEANERS (kg)



4.1.2 Light weaners

The fortnightly weight of light weaner pigs of the three treatments are shown in Table 4.2. and Fig. 4.2. In this group, treatment I showed a total gain of 54.16 kg (7.67 ± 0.543 kg to 61.83 ± 3.164 kg)from weaning to 14th fortnight. A total gain in weight for second treatment of 61.92 kg was recorded (8.08 ± 0.216 to 70.00 ± 4.621 kg) from weaning to 14th fortnight. In the case of third treatment, light weaners showed an increase from 8.50 ± 0.707 kg to 54.25 ± 5.480 kg giving a total gain of 45.75 kg from weaning to 14th fortnight. The results were found to be non-significant between plane of feeding throughout the experimental study.

In both heavy and light weaner pigs the NRC treatment showed a better growth rate and gain at puberty. In Fig. 4.3. the comparative body weight of heavy weaners and light weaners of all the treatments are presented.

FIG. 4.2. FORTNIGHTLY BODY WEIGHT OF LIGHT WEANERS (kg)

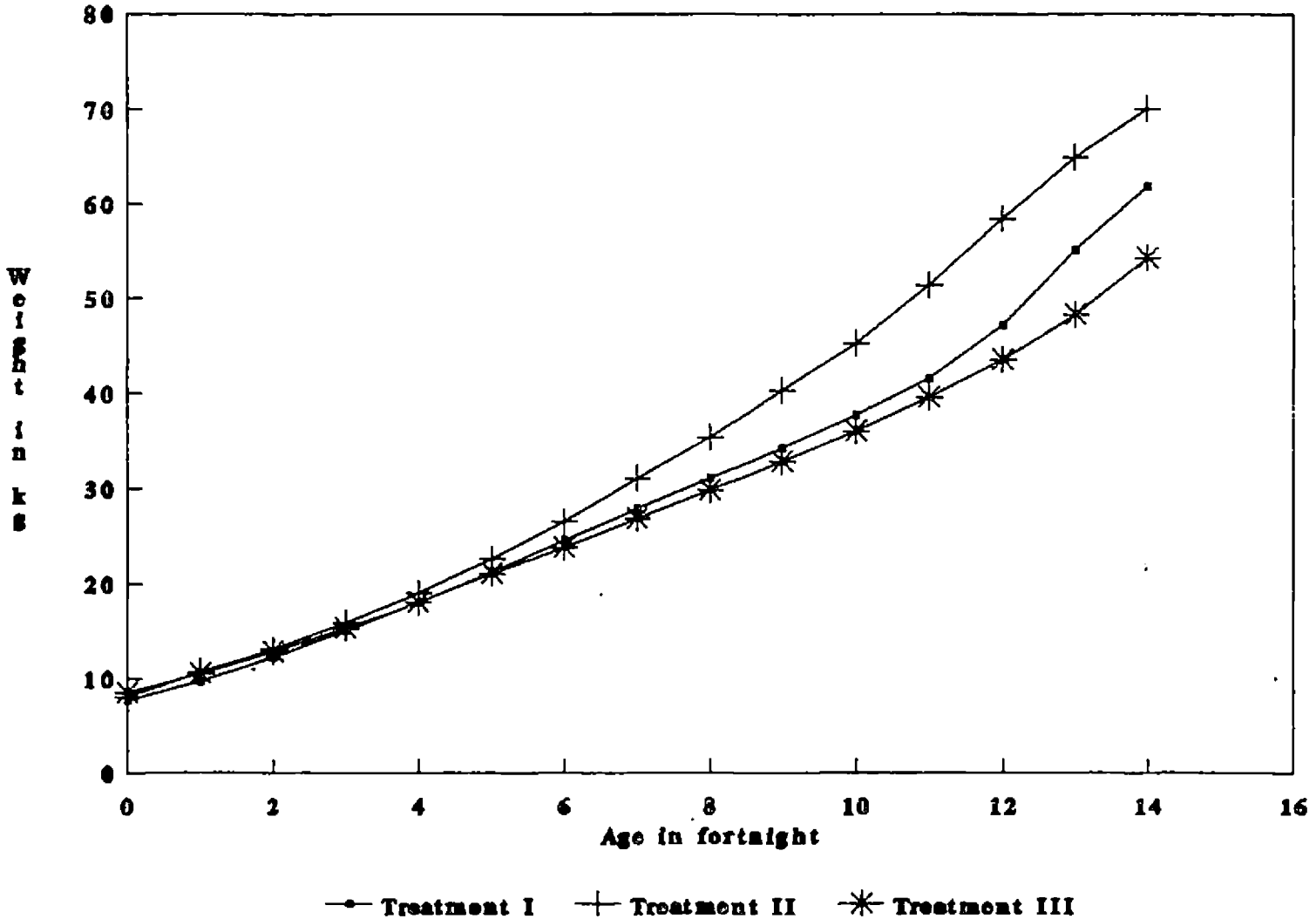
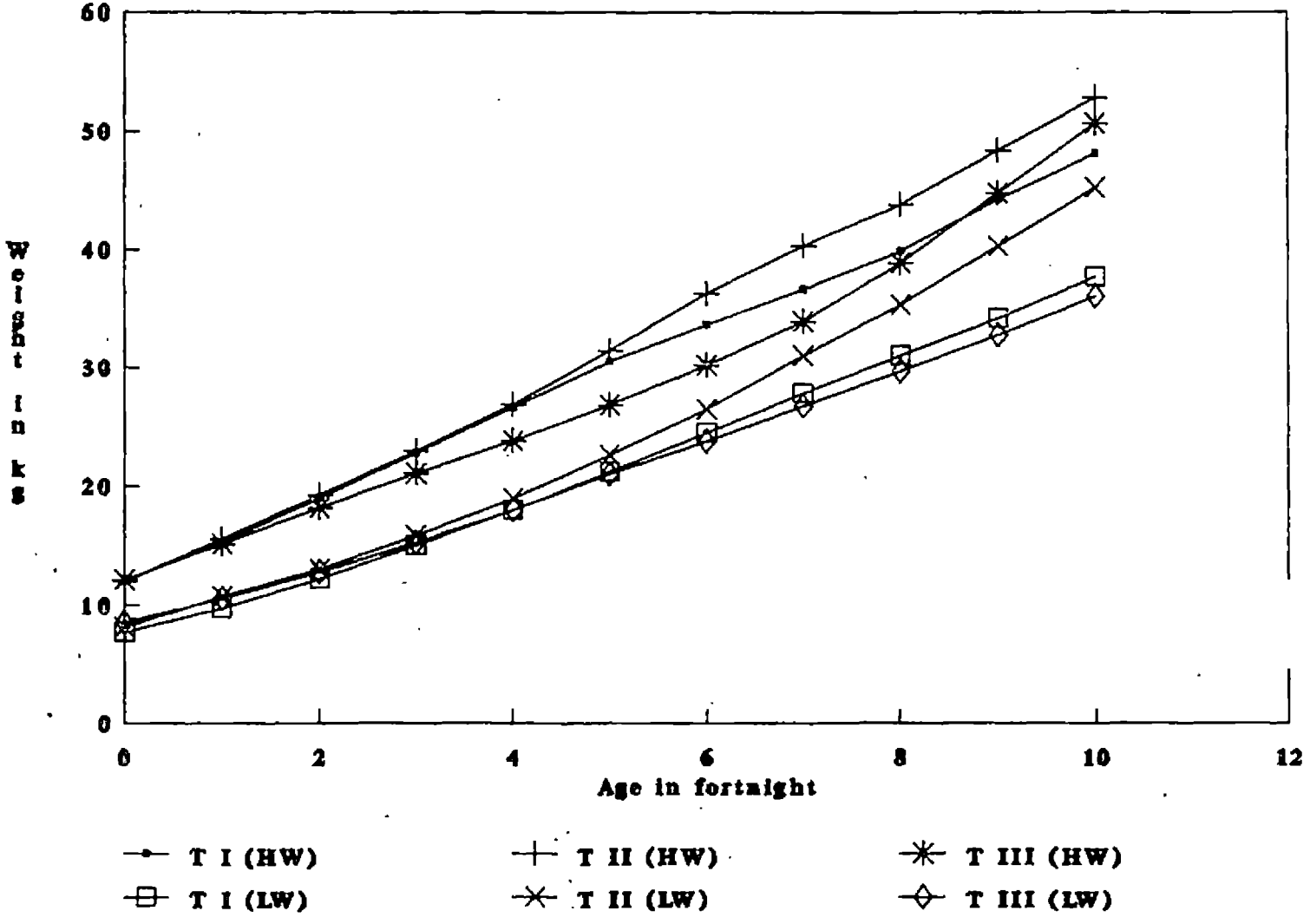


Table 4.2. Fortnightly body weight of Light Weaners (kg)

Fortnight	Treatment I [HP]	II [NRC]	III [LP]	f-value
Weaning weight	7.67±0.543	8.08±0.216	8.50±0.707	0.5348 NS
1	9.67±0.543	10.67±0.437	10.50±0.354	0.8182 NS
2	12.17±0.595	13.00±0.621	12.75±0.177	0.3312 NS
3	15.00±0.409	15.83±1.037	15.25±0.177	0.1524 NS
4	18.00±0.409	18.92±1.392	18.00±1.061	0.1211 NS
5	21.17±0.358	22.58±1.902	21.00±2.475	0.1549 NS
6	24.50±0.409	26.50±2.090	23.75±3.359	0.2967 NS
7	27.83±0.358	31.00±2.719	26.75±4.419	0.4252 NS
8	31.00±0.624	35.33±3.041	29.75±5.127	0.5943 NS
9	34.17±0.722	40.25±3.499	32.75±5.480	0.8706 NS
10	37.67±1.114	45.25±3.797	36.00±6.363	1.0914 NS
11	41.50±1.028	51.33±4.544	39.5±6.718	1.3414 NS
12	47.17±1.062	58.42±4.674	43.5±6.718	1.8714 NS
13	55.17±1.975	64.92±4.613	48.25±5.480	2.1028 NS
14	61.83±3.164	70.00±4.621	54.25±5.480	1.6767 NS
Total gain	54.16	61.92	45.75	

NS Non-significant

FIG. 4.3. COMPARATIVE FORTNIGHTLY BODY WEIGHT OF HEAVY AND LIGHT WEANERS (kg)



4.2. Fortnightly rate of growth

4.2.1 Heavy weaners

Table 4.3. and Fig.4.4. shows the average fortnightly growth rate of heavy weaners receiving three treatments. In all the treatments, the peak growth rate is noticed in ninth fortnight (4.38 ± 0.622 kg in first treatment, 4.50 ± 0.612 kg in second treatment and 5.92 ± 0.594 kg in third treatment). An initial peak rate of growth (4.83 ± 0.723 kg) was noticed in second treatment at sixth fortnight followed by a depression in growth rate and coming to peak in ninth fortnight. The variation in the growth rate exhibited between treatments was found to be non-significant .

The average fortnightly weight gain of heavy weaners during 10 fortnights of three treatments are given in Table 4.4. Comparison by t-test revealed no significant difference between treatments except between treatment I and II.

Table 4.3. Fortnightly rate of growth - Heavy weaners (kg)

Fortnight	Treatment I [HP]	II [NRC]	III [LP]	f-value
1	3.25±0.730	3.50±0.373	3.00±0.289	0.3679 NS
2	3.75±0.516	3.75±0.524	3.08±0.463	0.4962 NS
3	3.75±0.125	3.67±0.663	2.92±0.492	0.6077 NS
4	3.88±0.325	4.00±0.816	2.75±0.368	1.1564 NS
5	3.88±0.207	4.50±0.717	3.00±0.456	1.6554 NS
6	3.13±0.272	4.83±0.723	3.33±0.561	1.9705 NS
7	3.00±0.468	4.08±0.861	3.75±0.482	0.4808 NS
8	3.25±0.375	3.50±0.527	4.92±0.820	1.5646 NS
9	4.38±0.622	4.50±0.612	5.92±0.594	1.6261 NS
10	3.88±0.272	4.50±0.589	5.92±0.852	1.8499 NS
Mean	3.62±0.218	4.08±0.195	3.86±0.511	

NS - Non-significant

FIG. 4.4. FORTNIGHTLY RATE OF GROWTH - HEAVY WEANERS (kg)

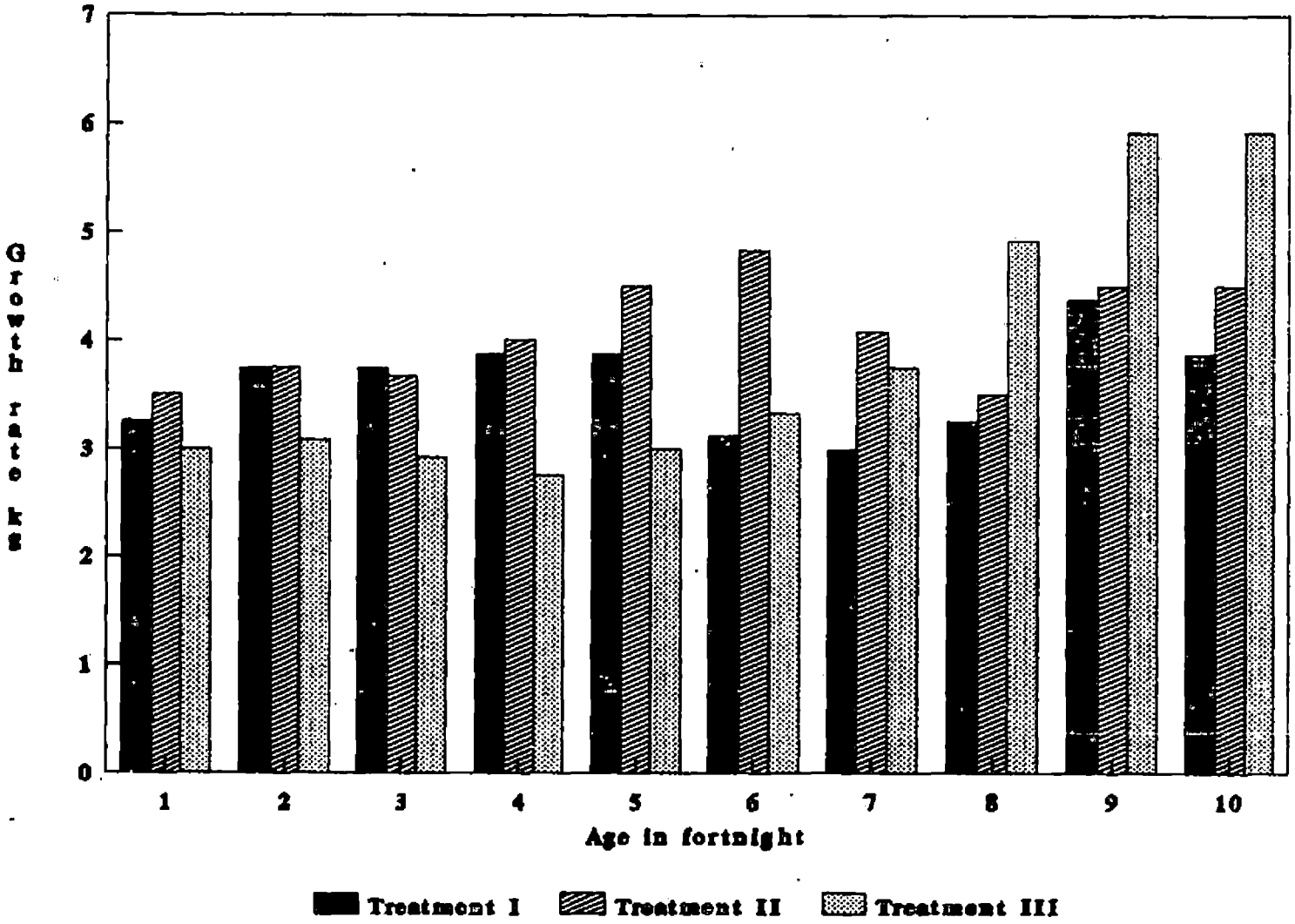


Table 4.4. Comparison of Average fortnightly weight gain of Heavy Weaners

Groups			Means		t-value
Treatment I (HP)		x	3.62±0.218	4.08±0.195	2.6556 *
Treatment II (NRC)					
Treatment I (HP)		x	3.62±0.218	3.86±0.511	0.6526 NS
Treatment III (LP)					
Treatment II (NRC)		x	4.08±0.195	3.86±0.511	0.5898 NS
Treatment III (LP)					

* Significant at 5 per cent.

NS Non-significant

4.2.2 Light weaners

The average fortnightly growth rate upto 14th fortnight of light weaners are presented in Table 4.5 and Fig. 4.5. The first treatment have the average gain ranging between 2.00 ± 0.000 to 8.00 ± 1.080 kg and peak growth rate at 13th (8.00 ± 1.080 kg) fortnight. In the second treatment, the peak growth rate was recorded at 12th fortnight (7.08 ± 0.362 kg) varying from 2.58 ± 0.274 to 7.08 ± 0.362 kg. The third treatment shows the peak growth rate (6.00 ± 0.000 kg) at 14th fortnight within a range of 2.00 ± 0.354 to 6.00 ± 0.000 kg. The variation exhibited in the fortnightly rate of growth from first to

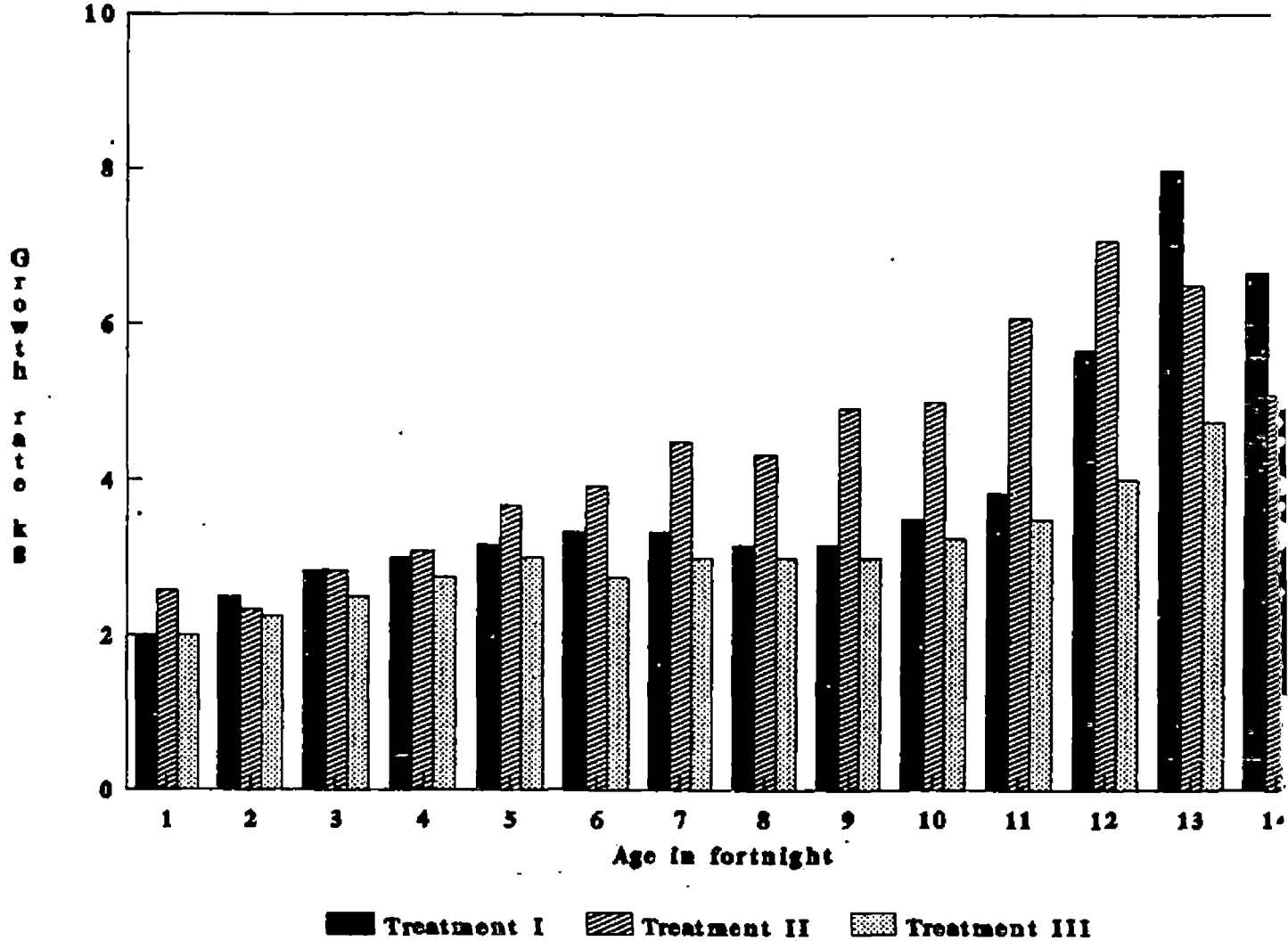
Table 4.5. Fortnightly rate of growth - Light Weaners (kg)

Fortnight	Treatment I [HP]	II [NRC]	III [LP]	f-value
1	2.00±0.000	2.58±0.274	2.00±0.354	1.1570 NS
2	2.50±0.236	2.33±0.385	2.25±0.530	0.5008 NS
3	2.83±0.360	2.83±0.714	2.50±0.000	- NS
4	3.00±0.000	3.08±0.681	2.75±0.884	_ NS
5	3.17±0.272	3.67±0.536	3.00±1.414	0.1914 NS
6	3.33±0.136	3.92±0.321	2.75±0.884	1.2727 NS
7	3.33±0.272	4.50±0.808	3.00±1.061	0.6617 NS
8	3.17±0.272	4.33±0.631	3.00±0.707	0.9840 NS
9	3.17±0.136	4.92±0.661	3.00±0.354	2.2068 NS
10	3.50±0.408	5.00±0.441	3.25±0.884	2.4282 NS
11	3.83±0.136	6.08±0.794	3.50±0.354	2.6738 NS
12	5.67±0.720	7.08±0.362	4.00±0.000	6.4767 *
13	8.00±1.080	6.50±0.373	4.75±1.237	2.3647 NS
14	6.67±1.298	5.08±0.432	6.00±0.000	0.9621 NS
Means	3.87±0.981	4.42±0.599	3.27±0.000	

* Significant at 5 per cent.

NS Non-significant

FIG. 4.5. FORTNIGHTLY RATE OF GROWTH - LIGHT WEANERS (kg.



14th fortnight when analysed statistically showed non-significant difference between treatments except during the 12th fortnight where the variation was found to be significant between treatment II and III.

Comparison by t - test of average fortnightly weight gain of light weaners for the period of 14 fortnights are presented in Table 4.6. The results shows a significant difference in weight gain between treatment I and III, a highly significant difference between treatment II and III and , a non-significant difference between treatment I and II.

Table 4.6. Comparison of fortnightly weight gain of Light Weaners

Groups	Means		t-value
Treatment I (HP) x Treatment II (NRC)	3.87±0.981	4.42±0.599	1.8310 NS
Treatment I (HP) x Treatment III (LP)	3.87±0.981	3.27±0.742	2.6087 *
Treatment II (NRC) x Treatment III (LP)	4.42±0.599	3.27±0.742	4.0783 **

* Significant at 5 per cent.

** Significant at 1 per cent.

NS Non-significant

Comparison of average fortnightly weight gain by t - test between heavy and light weaners of equal observations are given in Table 4.7. The average weight gain was 3.62 ± 0.218 kg for heavy weaners and 3.00 ± 0.260 kg for light weaners for the period of 10 fortnights in treatment I. In the case of treatment II the gain averaged 4.08 ± 0.195 and 3.72 ± 0.397 kg for heavy and light weaners respectively. The same was recorded as 3.86 ± 0.511 and 2.75 ± 0.276 kg in the third treatment. The analysis revealed a significant difference in treatment I and a highly significant difference in treatment III between heavy and light weaners. In the case of treatment II, there is no significant difference between heavy and light weaners.

Table 4.7. Comparison of Fortnightly weight gain of Heavy and Light Weaners (kg)

Treatment	Heavy Weaners	Light Weaners	t-value
I [HP]	3.62±0.218	3.00±0.260	3.2456 *
II [NRC]	4.08±0.195	3.72±0.397	1.4364 NS
III [LP]	3.86±0.511	2.75±0.276	3.3596 **

* Significant at 5 per cent.

** Significant at 1 per cent.

NS Non-Significant

4.3. Absolute gain in weight

4.3.1 Heavy weaners

The absolute daily gain was calculated for the three treatment groups of heavy weaners and the findings are presented in Table 4.8. and Fig. 4.6. The absolute gain in weight of first treatment showed a variation from 232 g in first fortnight to 277 g in 10th fortnight with reduced gain in sixth, seventh and eighth fortnight. The maximum gain in weight of 313 g was noticed in the ninth fortnight. In the case of second treatment, absolute gain varied from 250 g in first fortnight to 321 g in 10th fortnight giving a peak gain of 321 g in ninth and 10th fortnight. This group of pigs has also shown an initial peak rate of gain of 345 g in sixth fortnight followed by a variation in the gain and coming to peak gain in the ninth fortnight. A reduction in gain was observed in seventh and eighth fortnight. In case of third treatment, the rate of gain varied from 214 g to 423 g from first to 10th fortnight, showing a peak gain in weight of 423 g in the ninth and 10th fortnight.

In the case of heavy weaners, the gilts of all treatment exhibited signs of puberty between eighth and ninth fortnight.

Table 4.8. Absolute gain in weight of Heavy Weaners (g)

Fortnight	Treatment I [HP]	II [NRC]	III [LP]
1	232.00	250.00	214.00
2	268.00	268.00	220.00
3	268.00	262.00	208.00
4	277.00	286.00	197.00
5	277.00	321.00	214.00
6	223.00	345.00	238.00
7	214.00	291.00	268.00
8	232.00	250.00	351.00
9	313.00	321.00	423.00
10	277.00	321.00	423.00
Mean	258.10	291.50	275.10

4.3.2 Light weaners

In the case of light weaners absolute gain are shown in Table 4.9 and Fig. 4.7. In the first treatment group, the absolute gain varied from 143 to 571 g and maximum gain is seen in the 13th fortnight (571 g). In the second treatment the maximum absolute gain (506 g) is noticed in

FIG. 4.6. ABSOLUTE WEIGHT GAIN OF HEAVY WEANERS (g)

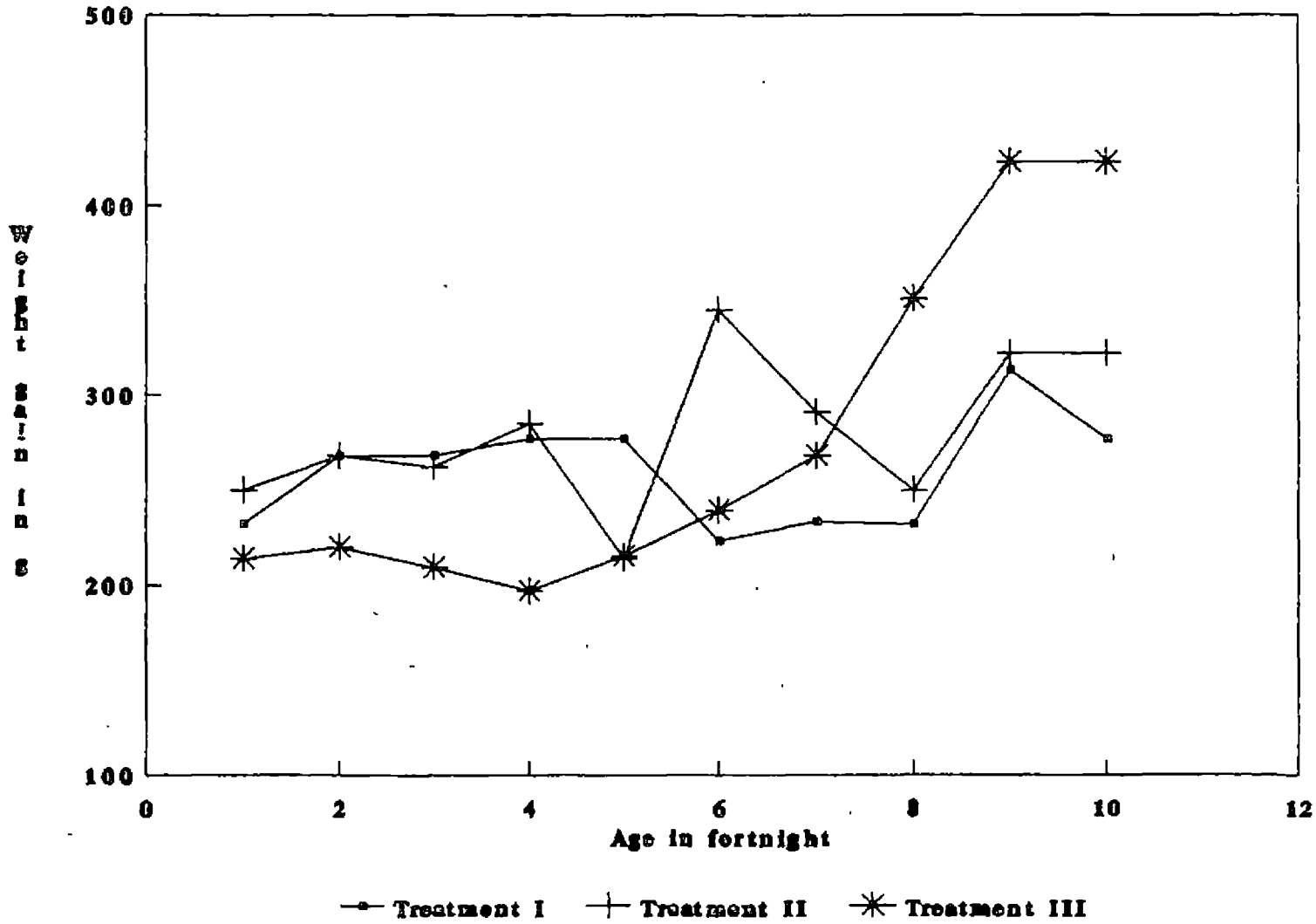
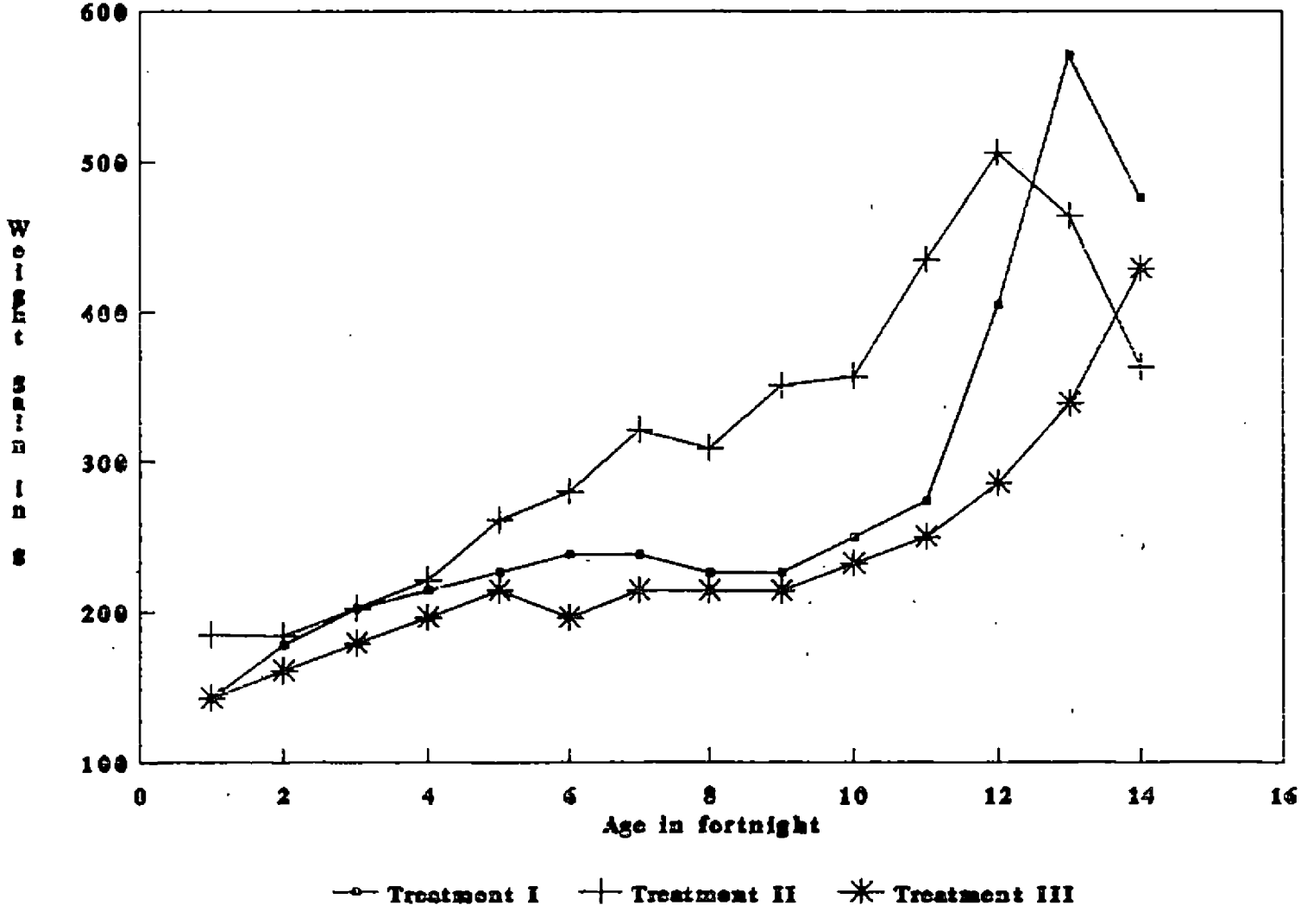


Table 4.9. Absolute gain in weight of Light Weaners (g)

Fortnight	Treatment I [HP]	II [NRC]	III [LP]
1	143.00	185.00	143.00
2	178.00	166.00	161.00
3	202.00	202.00	179.00
4	214.00	221.00	196.00
5	226.00	261.00	214.00
6	238.00	280.00	196.00
7	238.00	321.00	214.00
8	226.00	309.00	214.00
9	226.00	351.00	214.00
10	250.00	357.00	232.00
11	274.00	435.00	250.00
12	405.00	506.00	286.00
13	571.00	464.00	339.00
14	476.00	363.00	429.00
Mean	276.21	315.79	233.36

12th fortnight with a range from 166 to 506 g. The third treatment shows the peak absolute gain later than the other two treatments and is seen in 14th fortnight (429 g) ranging from 143 to 429 g. In all the treatments of the

FIG. 4.7. ABSOLUTE WEIGHT GAIN OF LIGHT WEANERS (g)



light weaners, the peak absolute gain was noticed between 12th and 14th fortnight and correspond with the onset of puberty.

4.4. Percentage of growth rate

4.4.1 Heavy weaners

Table 4.10 and Fig. 4.8. represent the growth rate expressed as percentage of previous fortnight's weight of heavy weaners. The percentage growth rate in all the treatments showed a general tendency of declining from first fortnight as the age advanced. In treatment I, II and III, maximum percentage of growth rate calculated are 27.08, 29.17 and 24.86 respectively in first fortnight. In the first two treatments the lowest percentage was noticed in the eighth fortnight (8.87 and 8.68 respectively) and then a mild increase thereafter. Whereas the lowest percentage of growth rate (12.43) was noticed in seventh fortnight in the case of treatment III and then a mild increase thereafter.

Table 4.10. Growth rate expressed as percentage of previous fortnight's weight (Heavy Weaners)

Fortnight	Treatment		
	I [HP]	II [NRC]	III [LP]
1	27.08	29.17	24.86
2	24.59	24.19	20.49
3	19.74	19.05	16.03
4	17.05	17.44	13.06
5	14.53	16.72	12.60
6	10.26	15.37	12.44
7	9.66	11.26	12.43
8	8.87	8.68	14.49
9	10.96	10.27	15.25
10	8.77	9.31	13.23

4.4.2 Light weaners

In the case of light weaners, the growth rate expressed as percentage of previous fortnight's weight (Table 4.11 and Fig. 4.9) also showed a declining tendency from first fortnight as the age advanced. In the first and second treatments, the maximum percentage of growth rate (26.03 per cent and 32.05 per cent respectively) reduced to a minimum in 11th fortnight (10.16 per cent) and 10th

FIG. 4.8. GROWTH RATE EXPRESSED AS PERCENTAGE OF PREVIOUS FORTNIGHT'S WEIGHT (HEAVY WEANERS)

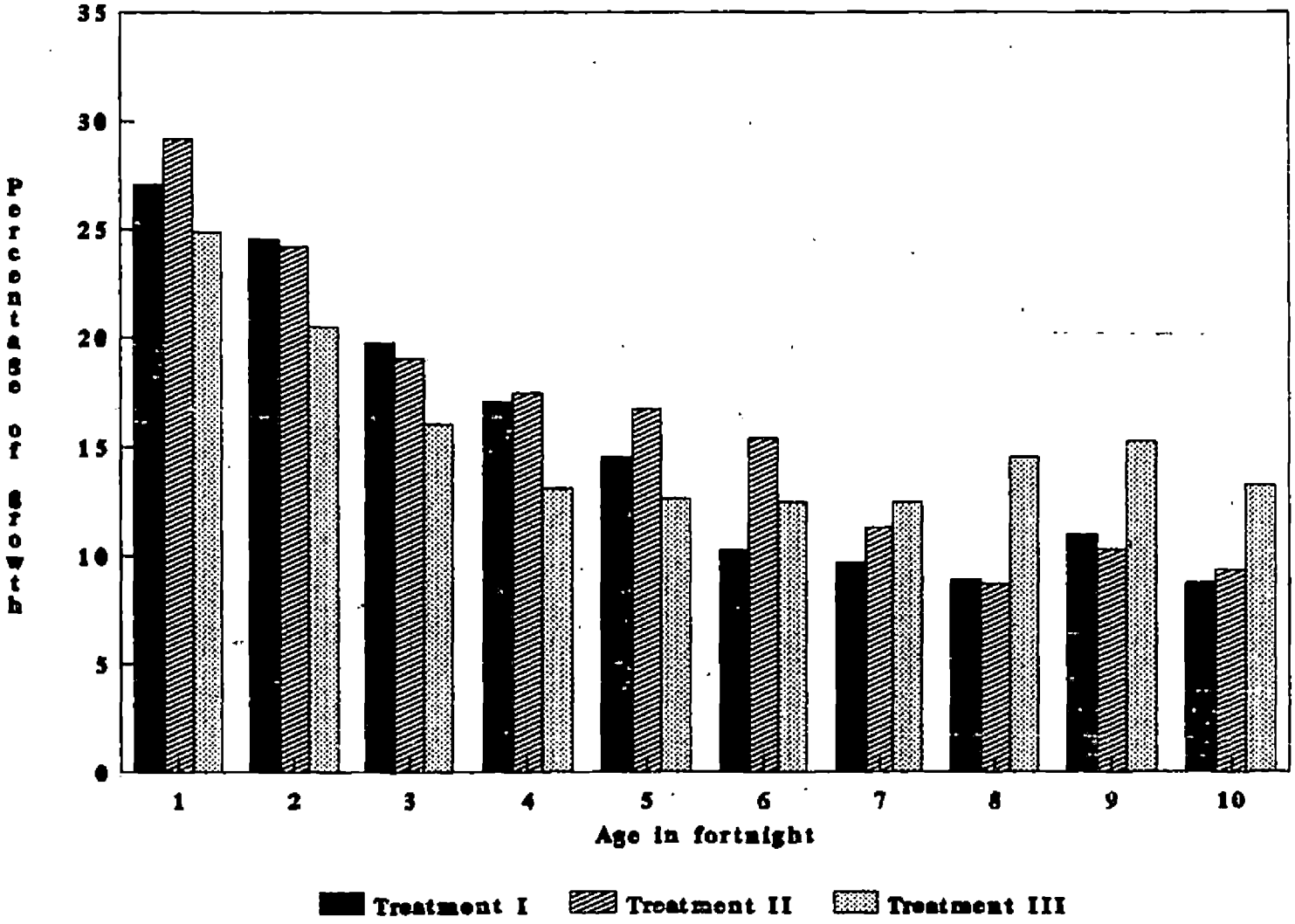
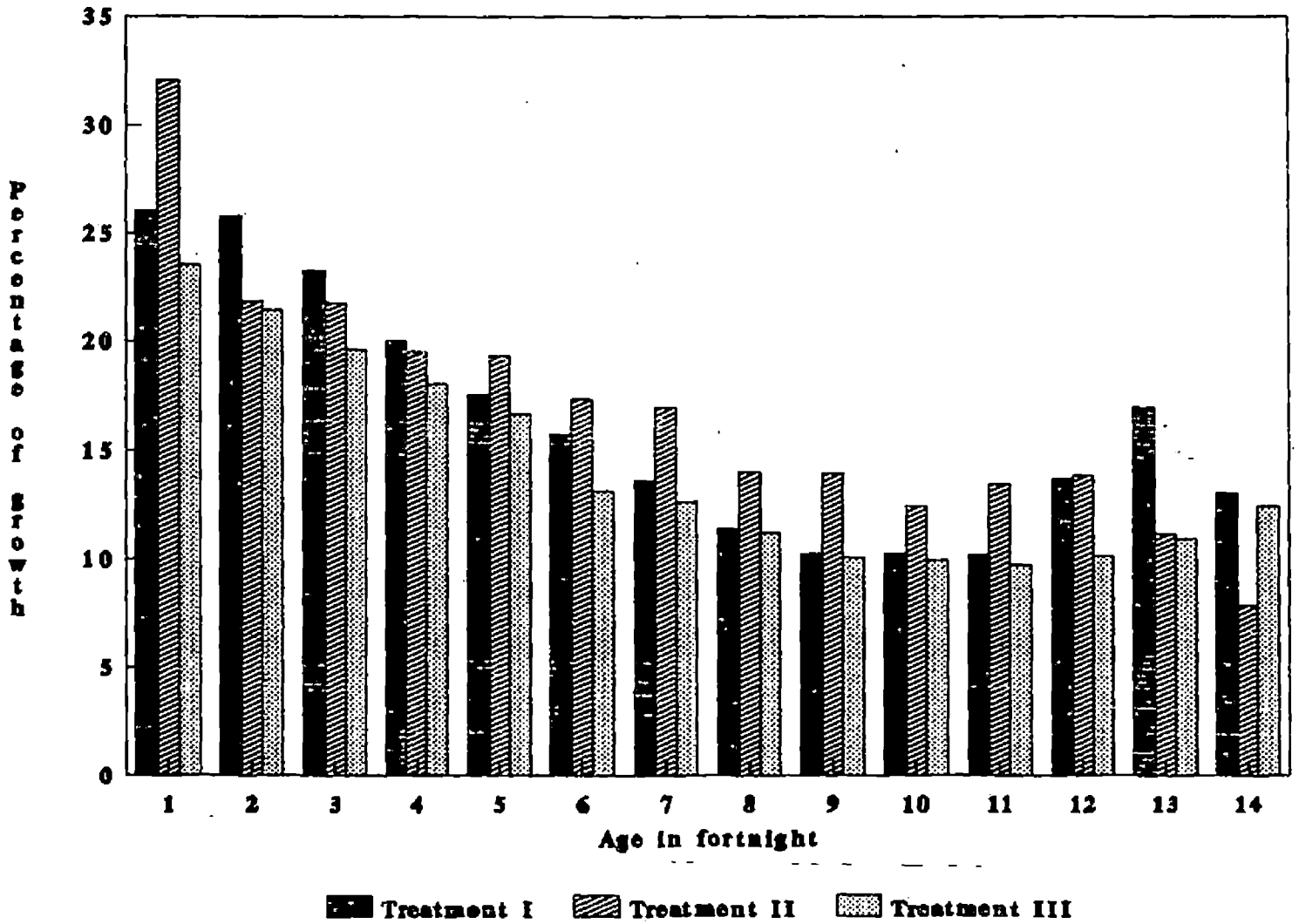


Table 4.11. Growth rate expressed as percentage of previous fortnight's weight (Light Weaners)

Fortnight	Treatment I [HP]	II [NRC]	III [LP]
1	26.03	32.05	23.53
2	25.82	21.84	21.43
3	23.25	21.77	19.61
4	20.00	19.52	18.03
5	17.59	19.34	16.67
6	15.73	17.36	13.10
7	13.61	16.98	12.63
8	11.39	13.97	11.21
9	10.22	13.93	10.08
10	10.23	12.42	9.92
11	10.16	13.44	9.72
12	13.65	13.81	10.13
13	16.96	11.13	10.92
14	13.02	7.825	12.44

fortnight (12.42 per cent) respectively and thereafter an irregular mild increase. In the case of treatment III, the percentage of growth rate showed a gradual decline from 23.53 per cent in the first fortnight to 9.72 per cent in 11th fortnight and thereafter gradually increase.

FIG. 4.9. GROWTH RATE EXPRESSED AS PERCENTAGE OF PREVIOUS FORTNIGHT'S WEIGHT (LIGHT WEANERS)



4.5. Age at puberty

Age at puberty of light and heavy weaners are shown in Table 4.12 and Fig. 4.10. The heavy weaners of treatment I attain puberty at 180.50 ± 3.580 days. In the case of second and third treatments, puberty was recorded at 182.00 ± 10.720 days and 188.33 ± 12.230 days respectively. Eventhough age at puberty showed slight variation between treatments, the difference was found to be non-significant.

Table 4.12. Age at Puberty (days)

Group	Treatment I [HP]	II [NRC]	III [LP]	f-value
Heavy Weaners	180.50± 3.580	182.00± 10.720	188.33± 12.230	0.12404 NS
Light Weaners	233.33± 1.440	229.83± 6.034	254.00± 19.090	0.27731 NS

NS Non-significant

In the case of light weaners the second treatment attain puberty earlier at 229.83 ± 6.034 days followed by first treatment 233.33 ± 1.440 days and third treatment at 254.00 ± 19.090 days. The result showed a variation in age at puberty between treatments but the analysis of

variance showed no significant difference between treatment to attain puberty.

The heavy weaners on an average were found to be significantly younger (184.00 ± 6.428 days) than light weaners (235.18 ± 5.783 days) (Table 4.13.1)

4.6. Weight at puberty

The body weight at puberty in Table 4.13 and Fig. 4.11 revealed that treatment I is having the lightest body weight in both light (51.00 ± 2.494 kg) and heavy weaners (42.13 ± 1.095 kg) followed by treatment III (53.50 ± 1.750 kg and 44.67 ± 1.527 kg respectively) and treatment II were found to be heaviest (58.42 ± 3.201 kg and 45.33 ± 2.119 kg respectively) at puberty. When the treatments are taken in general the light weaners on an average were found to be significantly heavier at puberty (55.50 ± 2.276 kg) than heavy weaners (44.28 ± 1.100 kg) (Table 4.13.1).

Table 4.13. Weight at Puberty (kg)

Group	Treatment I [HP]	II [NRC]	III [LP]	f-value
Heavy Weaners	42.130 ±1.095	45.330 ±2.119	44.670 ±1.527	0.6414 NS
Light Weaners	51.000 ±2.494	58.420 ±3.201	53.500 ±1.750	1.0655 NS

NS Non-significant

Table 4.13.1 Comparison of Heavy and Light Weaners

Traits	Heavy weaners	Light weaners	t - value
Age at puberty (days)	184.00±6.428	235.18±5.783	5.6039 **
Weight at puberty (kg)	44.28±1.100	55.50±2.276	4.8822 **
Oestrous cycle length (days)	20.19±0.293	20.45±0.365	0.5749 NS
1st oestrus period (hour)	42.75±1.633	40.91±1.951	0.7225 NS
2nd oestrus period (hour)	58.88±2.273	54.18±2.807	1.3051 NS

** Significant at 1 per cent.

NS Non-significant

FIG. 4.10. AGE AT PUBERTY

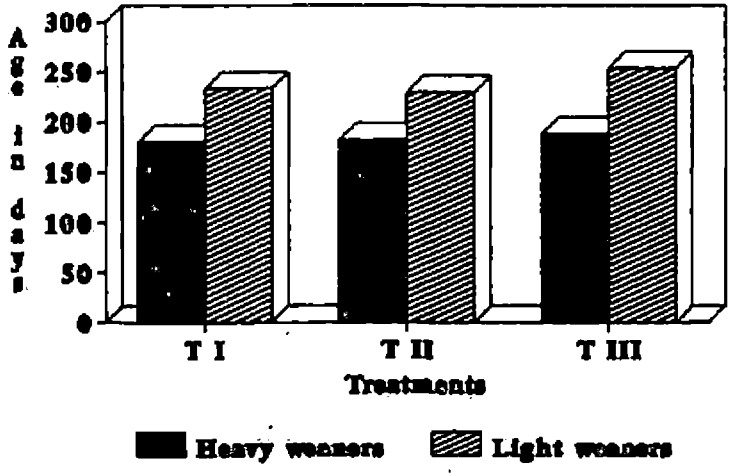
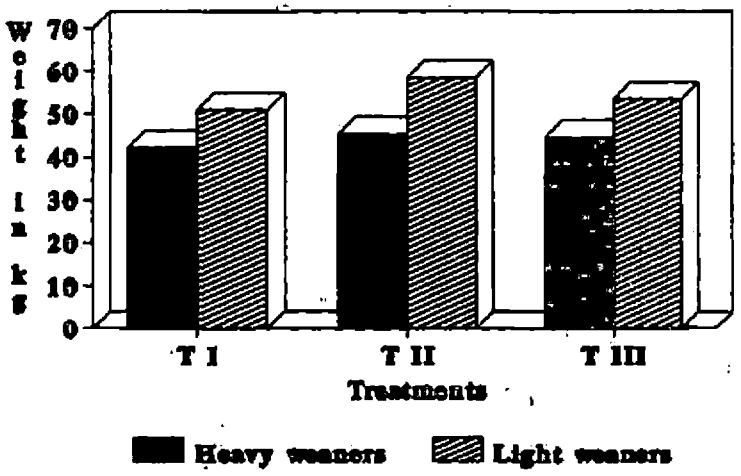


FIG. 4.11. WEIGHT AT PUBERTY



4.7. Oestrous cycle and oestrous period

4.7.1 Heavy weaners

The average oestrous cycle length and duration of oestrus are recorded in Table 4.14 and 4.15 respectively. In treatment I of heavy weaners, an oestrous cycle of 21.0 ± 0.790 days was noticed. This group of gilts remain in heat for a period of 39.00 ± 3.355 hour in the first oestrus. In the case of second oestrus they remain in heat for a longer period of 51.00 ± 3.335 hour. In the case of second treatment of heavy weaners an average oestrous cycle length of 20.00 ± 3.335 days was recorded. The oestrous period noticed in this treatment was 42.00 ±2.000 hour in first oestrus and 56.00 ± 2.311 hour in the second oestrus. An oestrous cycle of 19.83 ± 0.282 days was noticed in treatment III of heavy weaners. They recorded an oestrous period of 46.00 ± 2.311 hour and 67.00 ± 2.200 hour in the first and second oestrus respectively. Analysis of variance of oestrous cycle length and first oestrous period revealed no significant differences between treatments. In the case of second oestrus of heavy weaners, analysis of variance showed a highly significant difference between treatment I and III, and treatment II and III.

4.7.2 Light weaners

The oestrous cycle length noticed in the case of

treatment I, II and III of light weaners were 21.00 ± 0.814, 20.33 ± 0.384 and 19.50 ± 0.354 days respectively. The first treatment of this group recorded an oestrous period of 38.00 ± 4.319 hour in first oestrus and 46.67 ± 4.752 hour in second oestrus. The oestrous periods noticed in the second treatment of this group were 41.00 ± 2.200 hour in first oestrus and 54.00 ± 2.000 hour in second oestrus. The same for treatment III of first and second oestrus noted were 45.00 ± 2.121 and 66.00 ± 4.243 hour respectively. Analysis of variance showed non-significant difference between treatment in oestrous cycle, first and second oestrous period.

Comparison by t - test between heavy and light weaners revealed no significant difference in oestrous cycle length, first and second oestrous period (Table 4.13.1).

Table 4.14. Length of Oestrous cycle (days)

Group	Treatment I [HP]	II [NRC]	III [LP]	f-value
Heavy Weaners	21.00±0.790	20.00±0.335	19.83±0.282	1.3919 NS
Light Weaners	21.00±0.814	20.33±0.384	19.50±0.354	0.9090 NS

NS Non-Significant.

Table 4.15. Duration of Oestrous period (hour)

Group	Oestrus period	I [HP]	II [NRC]	III [LP]	f-value
Heavy Weaners	1	39.00± 3.355	42.00± 2.000	46.00± 2.311	1.5494 NS
	2	51.00± 3.335	56.00± 2.311	67.00± 2.200	8.2589 **
Light Weaners	1	38.00± 4.319	41.00± 2.200	45.00± 2.121	0.6545 NS
	2	46.67± 4.752	54.00± 2.000	66.00± 4.243	4.2895 NS

** Significant at 1 per cent.

NS Non-Significant.

4.8. Oestrous behaviour

The oestrous behaviour observed during oestrus of light and heavy weaners are shown in Table 4.16.

4.8.1 Heavy weaners

In the heavy weaner, treatment I recorded a lowest score of 1.33 ± 0.120 followed by treatment II (2.02 ± 0.163) and treatment III scored the highest (2.85 ± 0.069). The variation in oestrous behaviour score when analysed shows a highly significant difference between treatments.

4.8.2 Light weaners

In the case of light weaners the oestrous behavioural score of treatment I, II and III are 1.40 ± 0.064, 2.30 ± 0.184 and 3.08 ± 0.092 respectively. The analysis of variance shows a highly significant difference between treatments.

Table 4.16. Mean Behavioural scores during oestrus

Group	Treatment			f-value
	I [HP]	II [NRC]	III [LF]	
Heavy Weaners	1.33±0.120	2.02±0.163	2.85±0.069	26.6713**
Light Weaners	1.40±0.064	2.30±0.184	3.08±0.092	17.4189**

** Significant at 1 per cent.

4.9. Daily feed intake

4.9.1 Heavy weaners

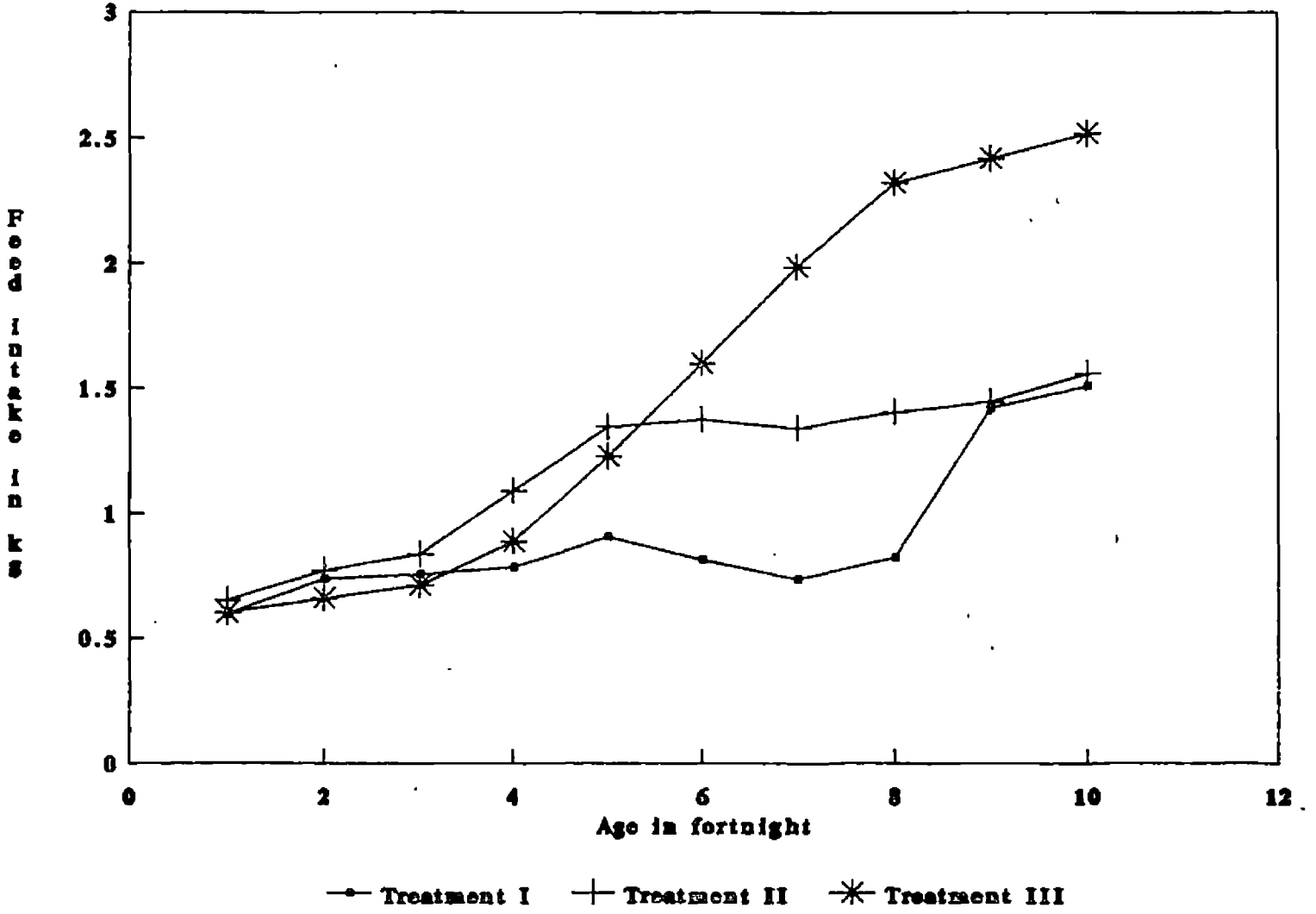
The average feed intake of heavy weaners are presented in Table 4.17 and Fig. 4.12. of the three treatments upto 10th fortnight. The average feed intake of first treatment increased from 0.595 kg in the first fortnight to 1.510 kg in the 10th fortnight. A reduction

Table 4.17. Daily feed intake of Heavy Weaners (kg)

Fortnight	Treatment		
	I [HP]	II [NRC]	III [LP]
1	0.595	0.651	0.602
2	0.736	0.767	0.656
3	0.753	0.834	0.711
4	0.783	1.088	0.885
5	0.905	1.346	1.227
6	0.813	1.374	1.599
7	0.734	1.341	1.985
8	0.820	1.405	2.320
9	1.422	1.445	2.417
10	1.510	1.560	2.518
Mean	0.907	1.181	1.492

in feed consumption in this treatment was noticed in sixth, seventh and eighth fortnights. The average daily feed intake increased from 0.651 kg to 1.560 kg in the second treatment with a mild reduction in seventh fortnight (1.341 kg). In the case of treatment III, the average feed intake increased from 0.602 kg to 1.227 kg from first to fifth fortnight and thereafter showed a

FIG. 4.12. DAILY FEED INTAKE OF HEAVY WEANERS (kg)



considerable increase from sixth fortnight (1.599 kg) to 10th fortnight (2.518 kg).

The average daily feed intake of treatment III was considerably more than treatment I and II especially from sixth to 10th fortnight.

4.9.2 Light weaners

The average feed intake of light weaners from first to 14th fortnight are recorded in Table 4.18 and Fig. 4.13. The feed intake of treatment I recorded an increase from first fortnight (0.389 kg) to 13th fortnight (1.809 kg) with mild reduction in seventh and 12th fortnight. The same in treatment II increased from 0.604 kg in the first fortnight to 2.048 kg in the 14th fortnight with reduced feed intake in second fortnight (0.541 kg). In the third treatment the average daily feed intake increased from 0.409 kg in first fortnight to 1.954 kg in the 14th fortnight. In this treatment, there is reduction of feed intake in sixth (0.634 kg) and seventh (0.632 kg) fortnight. Feed intake was more in the second treatment in this group of pigs, whereas feed intake was seen considerably low in the case of first treatment.

Table 4.18. Daily feed intake of Light Weaners (kg)

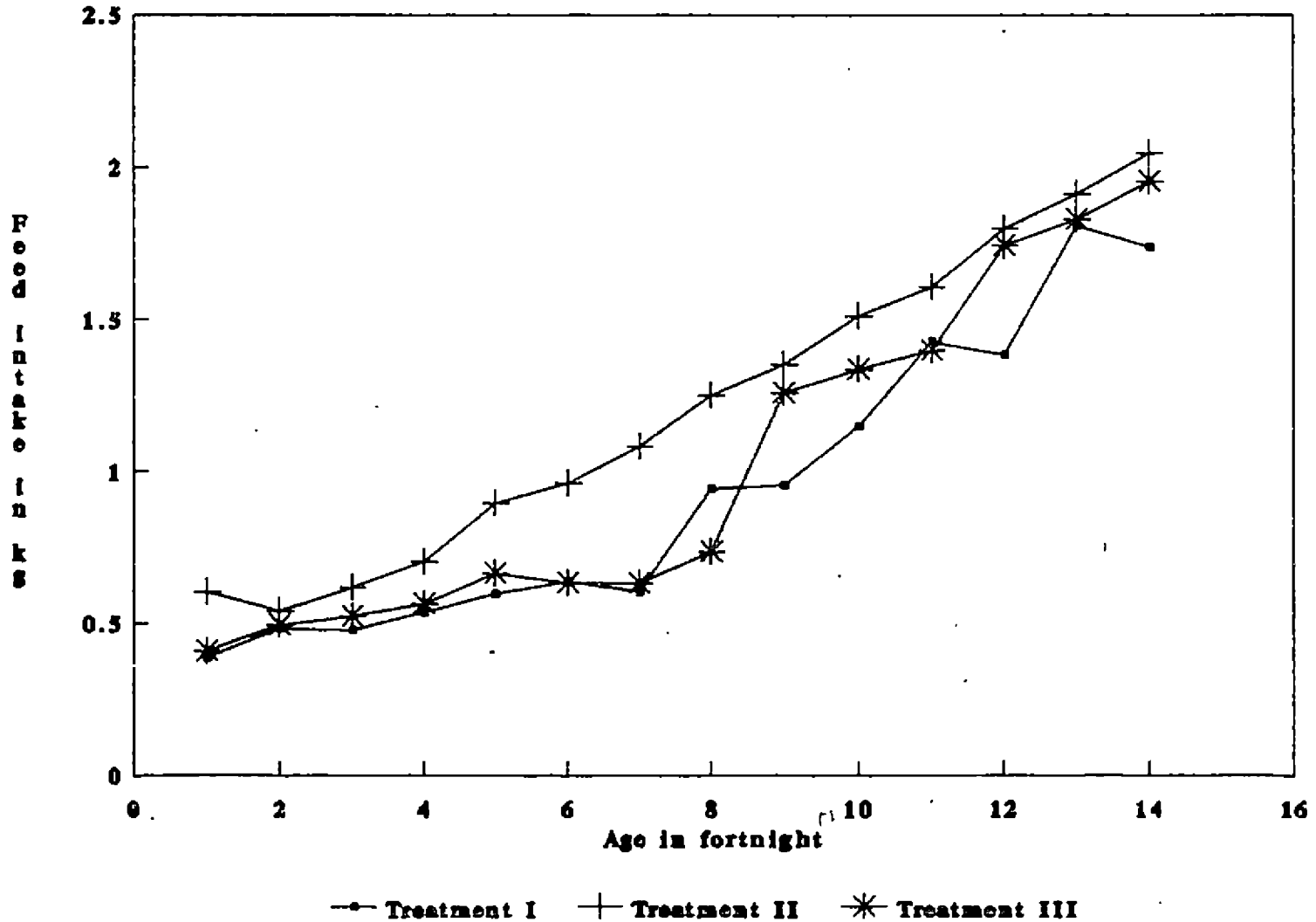
Fortnight	Treatment		
	I [HP]	II [NRC]	III [LP]
1	0.389	0.604	0.409
2	0.482	0.541	0.495
3	0.477	0.617	0.523
4	0.537	0.703	0.564
5	0.597	0.895	0.664
6	0.638	0.961	0.634
7	0.604	1.082	0.632
8	0.943	1.251	0.734
9	0.954	1.352	1.126
10	1.150	1.512	1.337
11	1.428	1.607	1.400
12	1.385	1.799	1.743
13	1.809	1.912	1.830
14	1.740	2.048	1.954
Mean	0.938	1.206	1.003

4.10. Average fortnightly feed intake

4.10.1 Heavy weaners

The average fortnightly feed intake of heavy

FIG. 4.13. DAILY FEED INTAKE OF LIGHT WEANERS (kg)



weaners are given in Table 4.19 and Fig. 4.14. The average fortnightly feed intake of treatment I increased from 8.33 kg in first fortnight to 21.14 kg in 10th fortnight. A reduction in the feed consumption in this treatment was noticed in the sixth, seventh and eighth fortnight. In the case of treatment II average fortnightly feed intake increased from 9.12 kg to 21.84 kg during the period of 10 fortnights with reduced feed intake in seventh fortnight (18.77 kg). In treatment III, the average fortnightly feed intake ranged from 8.43 kg in the first fortnight to 17.18 kg in the fifth fortnight and thereafter showed a considerable increase from sixth fortnight (22.39 kg) to 10th fortnight (35.25 kg). In this group of heavy weaners, the mean fortnightly feed intake of treatment III (20.89 kg) was found to be more than treatment I (12.70 kg) and II (16.54 kg). The feed intake of treatment III was considerably high especially from sixth to 10th fortnight.

Comparison of average fortnightly feed intake of heavy weaners showed highly significant difference between HP and NRC and, HP and LP with the exception of NRC and LP (Table 4.20) which shows no significant difference.

Table 4.19. Fortnightly feed intake of Heavy Weaners (kg)

Fortnight	Treatment		
	I [HP]	II [NRC]	III [LP]
1	8.33	9.12	8.43
2	10.31	10.74	9.19
3	10.54	11.68	9.96
4	10.96	15.23	12.39
5	12.67	18.85	17.18
6	11.38	19.24	22.39
7	10.28	18.77	27.79
8	11.48	19.67	32.48
9	19.91	20.23	33.84
10	21.14	21.84	35.25
Mean	12.70	16.54	20.89

FIG. 4.14. FORTNIGHTLY FEED INTAKE OF HEAVY WEANERS (kg)

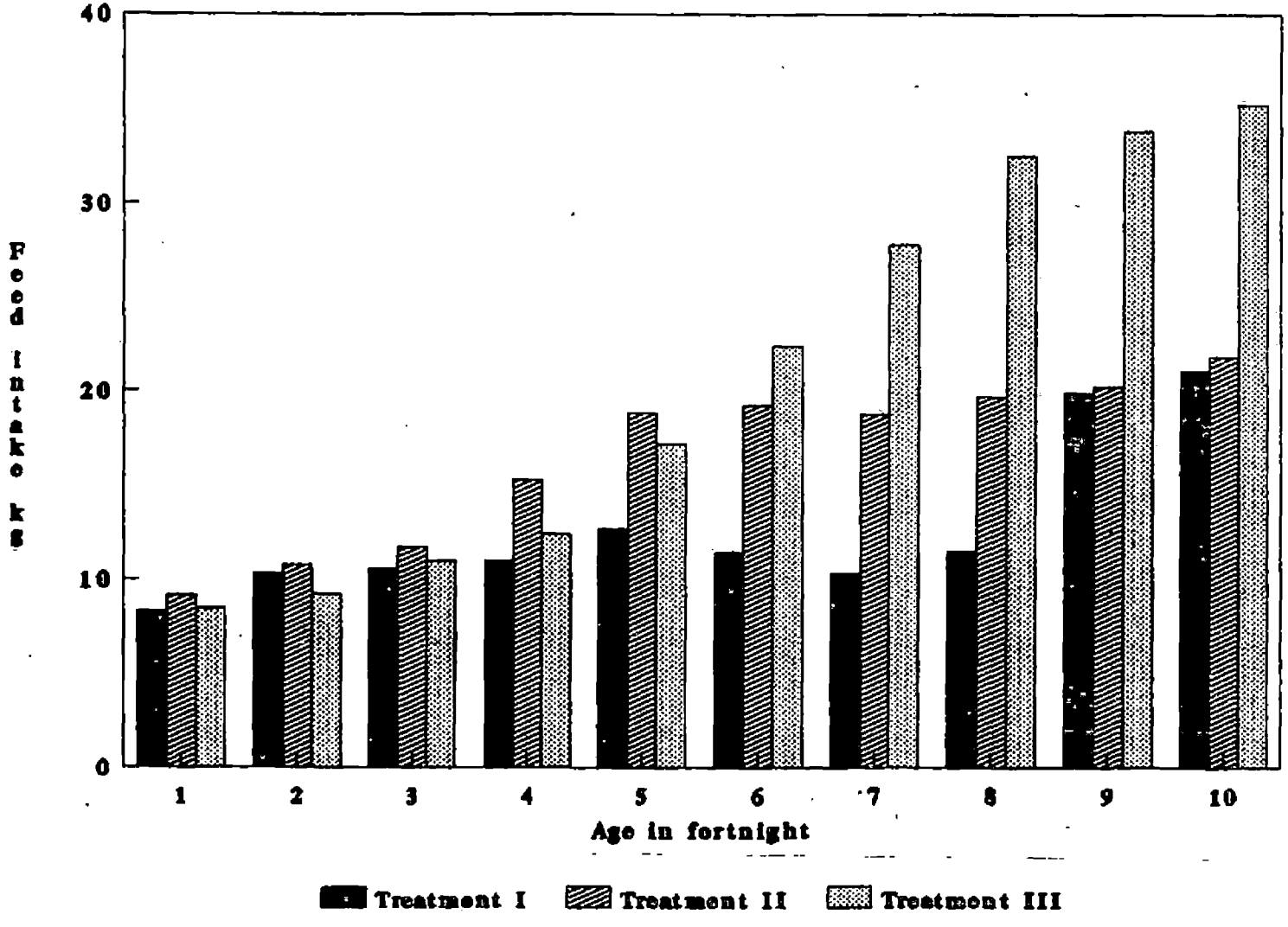


Table 4.20. Comparison of Fortnightly Feed intake of Heavy Weaners

Groups	Means		t-value
Treatment I (HP)x Treatment II (NRC)	12.70±2.139	16.537±1.842	3.4268 **
Treatment I (HP)x Treatment III(LP)	12.70±2.139	20.890±4.422	3.1326 **
Treatment II (NRC)x Treatment III (LP)	16.54±1.842	20.890±4.422	1.9518 NS

** Significant at 1 per cent.

NS Non-significant

4.10.2 Light weaners

In the case of light weaners group, the average fortnightly feed intake upto 14th fortnight are shown in Table 4.21 and Fig. 4.15 for three treatments. Treatment I had an increasing average fortnightly feed intake from first (5.44 kg) to 13th fortnight (25.32 kg) with reduced feed intake in seventh and 12th fortnight. The same in treatment II increased from first (8.45 kg) to 14th fortnight (28.67 kg) and shows a reduced feed intake in second fortnight (7.57 kg). In treatment III, the average fortnightly feed intake increased from 5.73 kg (first fortnight) to 27.35 kg (14th fortnight) with a mild decrease at sixth and seventh fortnight (8.87 and 8.85 kg

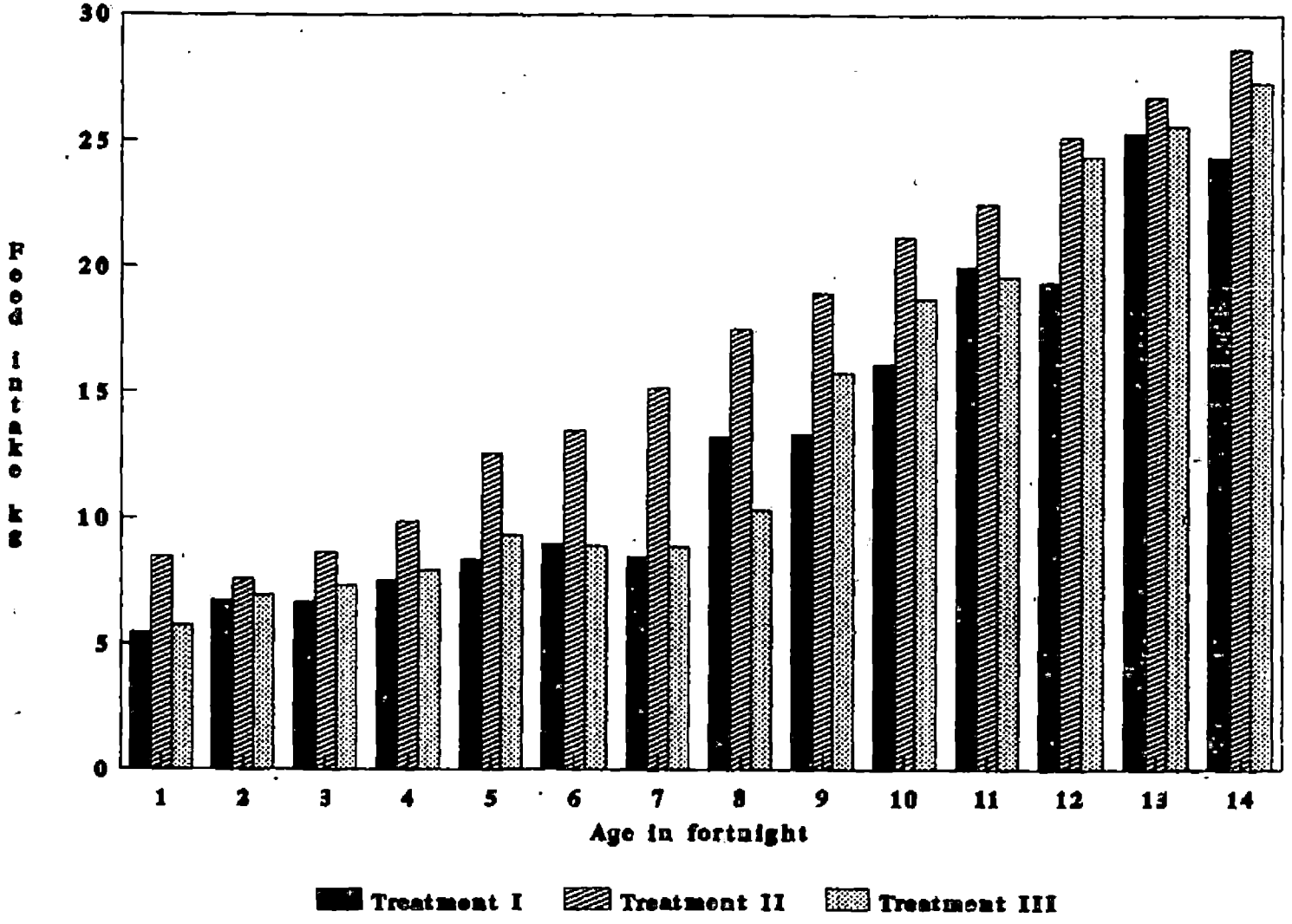
respectively).

Table 4.21. Fortnightly feed intake of Light Weaners (kg)

Fortnight	Treatment		
	I [HP]	II [NRC]	III [LP]
1	5.44	8.45	5.73
2	6.75	7.57	6.93
3	6.68	8.64	7.32
4	7.52	9.84	7.90
5	8.36	12.53	9.30
6	8.93	13.45	8.87
7	8.46	15.15	8.85
8	13.21	17.52	10.28
9	13.36	18.93	15.77
10	16.10	21.17	18.72
11	19.99	22.50	19.60
12	19.39	25.18	24.40
13	25.32	26.77	25.62
14	24.37	28.67	27.35
Mean	13.13	16.88	14.05

The mean fortnightly feed intake was more in the

FIG. 4.15. FORTNIGHTLY FEED INTAKE OF LIGHT WEANERS (kg)



second treatment (16.88 kg) of light weaners and comparatively low in the case of first treatment (13.13 kg) followed by treatment III (14.05 kg).

The average fortnightly feed intake of light weaners when analysed by t - test showed a highly significant difference between treatments (Table 4.22) except in between treatment I and III which shows no significant difference.

Table 4.22. Comparison of fortnightly feed intake of Light Weaners

Groups	Means		t-value
Treatment I (HP) x Treatment II (NRC)	13.13±3.939	16.88±2.929	7.9524 **
Treatment I (HP) x Treatment III(LP)	13.13±3.939	14.05±5.432	1.8217 NS
Treatment II (NRC) x Treatment III (LP)	16.88±2.929	14.05±5.432	5.3013 **

** Significant at 1 per cent.

NS Non-significant

The average fortnightly feed intake upto 10th fortnight was compared by t - test between heavy and light weaners (Table 4.23).The result revealed a highly significant difference in feed intake in all the

treatments.

Table 4.23. Comparison of fortnightly feed intake (kg) of Heavy and Light Weaners (kg)

Treatment	Heavy Weaners	Light Weaners	t-value
I [HP]	12.700±2.139	9.481±2.026	4.6394**
II [NRC]	16.539±1.482	13.325±1.951	4.8822**
III [LP]	20.890±4.422	9.967±2.903	4.4485**

** Significant at 1 per cent.

4.11. Fortnightly feed conversion efficiency (FCE)

4.11.1 Heavy weaners

The average fortnightly feed conversion efficiency of heavy weaners are shown in Table 4.24 and Fig. 4.16. In treatment I, feed conversion efficiency was maximum in the first fortnight (2.56 kg feed / kg gain) which steadily decreased during the course of time upto 10th fortnight (5.45 kg feed / kg gain). Heavy weaners on treatment II and III also showed a similar decline in feed efficiency upto eighth or seventh fortnight respectively after which there was an improving trend.

Table 4.24. Fortnightly feed conversion efficiency of Heavy Weaners

Fortnight	Treatment		
	I [HP]	II [NRC]	III [LP]
1	2.56	2.61	2.81
2	2.75	2.86	2.98
3	2.81	3.18	3.41
4	2.82	3.81	4.51
5	3.27	4.19	5.73
6	3.64	3.98	6.72
7	3.43	4.60	7.41
8	3.53	5.62	6.60
9	4.55	4.50	5.72
10	5.45	4.85	5.95
Mean	3.48	4.02	5.18

When the feed conversion efficiency is taken as a whole, it was found to be highest in HP (3.48 $\pm$ 0.453) followed by NRC (4.02 $\pm$ 0.383) and lowest in LP (5.18 $\pm$ 0.675). Comparison by t - test showed a highly significant difference between treatments except between HP and NRC (Table 4.25).

FIG. 4.16. FORTNIGHTLY FEED CONVERSION EFFICIENCY OF HEAVY WEANERS

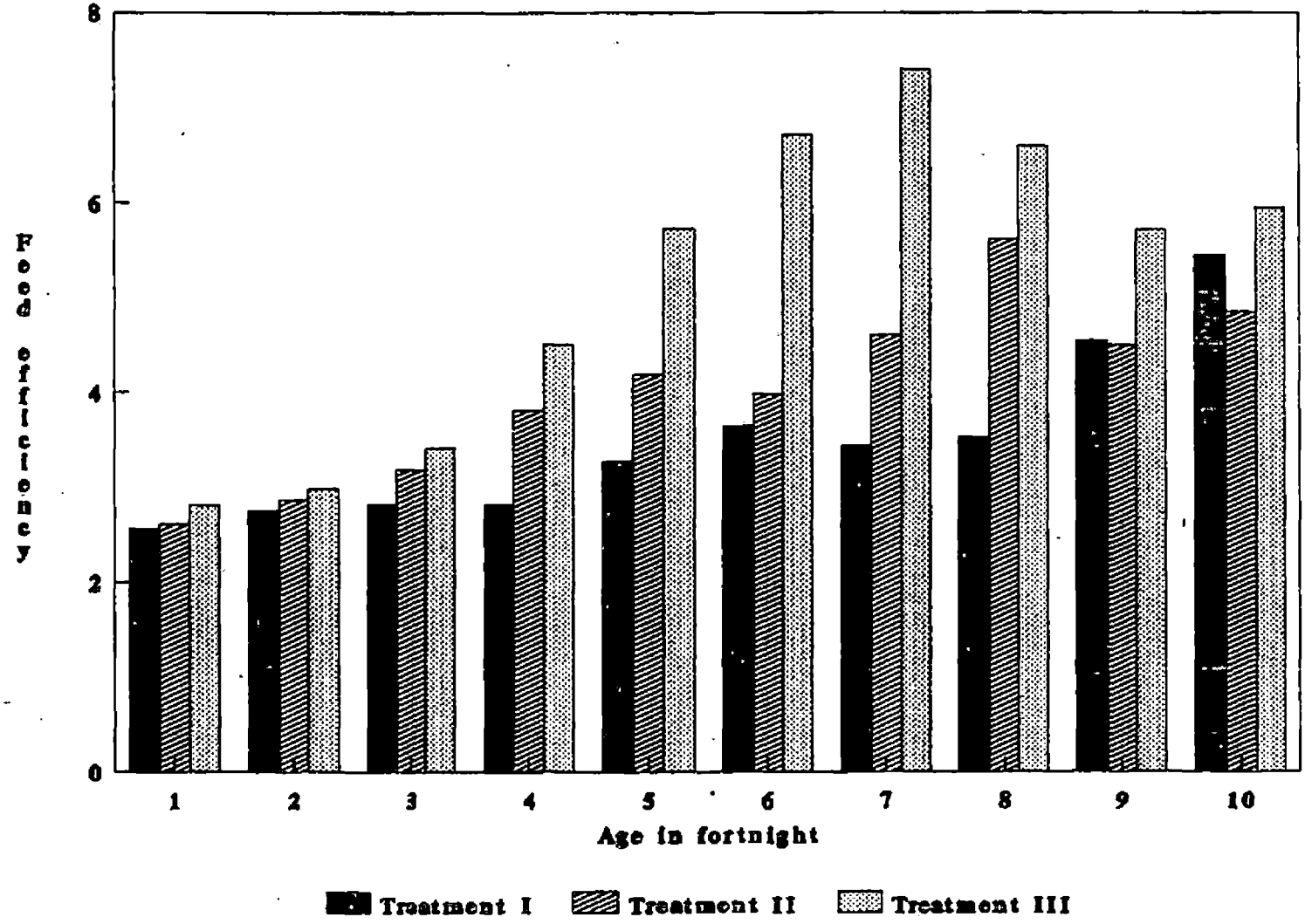


Table 4.25. Comparison of fortnightly feed conversion efficiency of Heavy Weaners

Groups	Means		t-value
Treatment I (HP) x Treatment II (NRC)	3.48±0.453	4.02±0.383	2.2237 NS
Treatment I (HP) x Treatment III (LP)	3.48±0.453	5.18±0.675	3.9474 **
Treatment II (NRC) x Treatment III (LP)	4.02±0.383	5.18±0.675	3.7915 **

** Significant at 1 per cent.

NS Non-significant

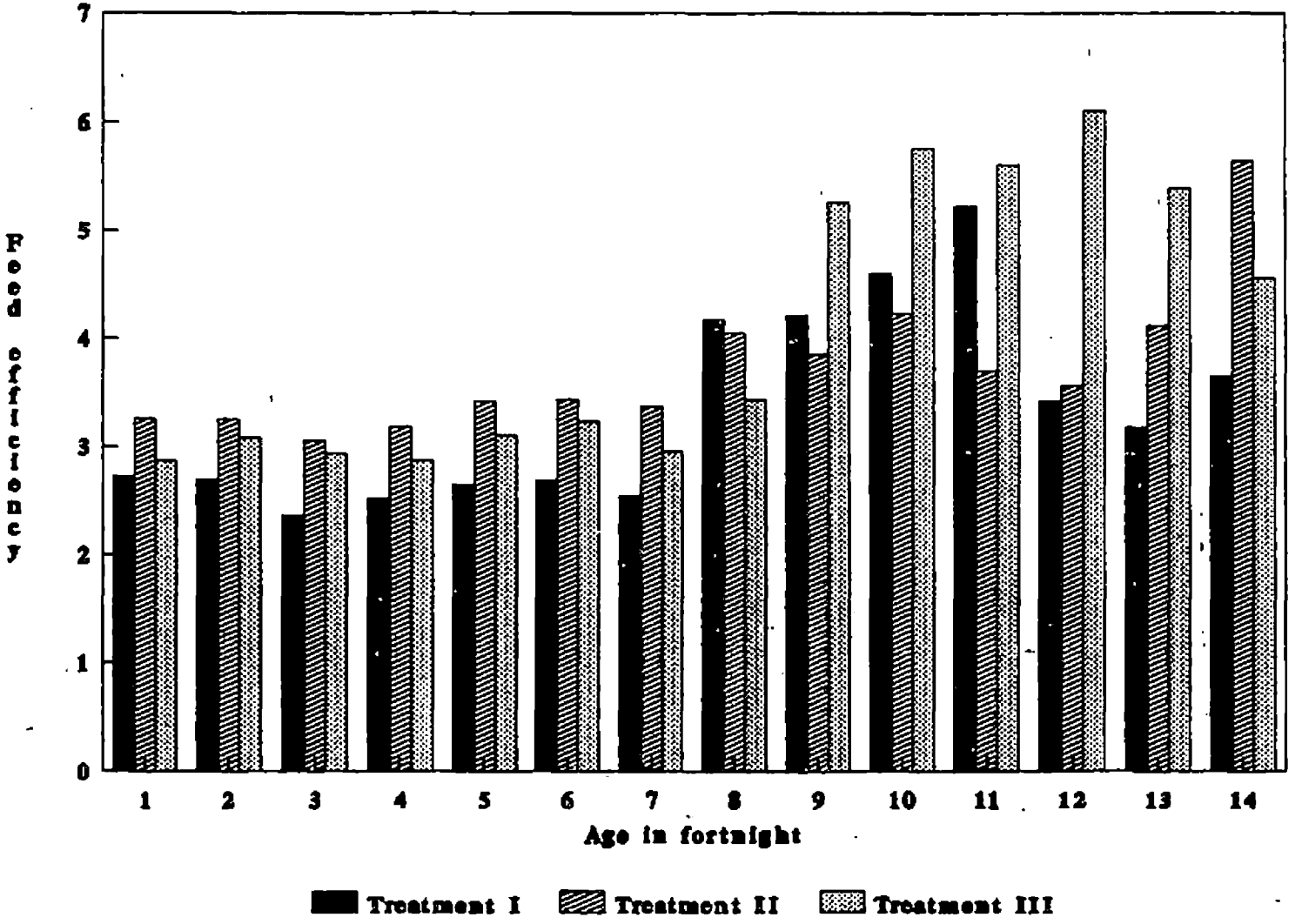
4.11.2 Light weaners

Fortnightly feed conversion efficiency of light weaners upto 14th fortnight are presented in Table 4.26. and Fig. 4.17. Treatment I shows a better feed conversion efficiency during the first seven fortnights (2.36 to 2.72) and again from 12th to 14th fortnight (3.17 to 3.65). The feed conversion efficiency was decreased between eighth and 11th fortnight (4.17 to 5.22). In the second treatment a steady feed conversion efficiency was noticed between first to seventh fortnight (3.05 to 3.43) followed by reduction in feed conversion efficiency thereafter upto 14th fortnight. Even in the case of third

Table 4.26. Feed conversion efficiency of Light Weaners

Fortnight	Treatment		
	I [HP]	II [NRC]	III [LP]
1	2.72	3.26	2.87
2	2.70	3.25	3.08
3	2.36	3.05	2.93
4	2.51	3.18	2.87
5	2.64	3.42	3.10
6	2.68	3.43	3.23
7	2.54	3.37	2.95
8	4.17	4.05	3.43
9	4.21	3.85	5.26
10	4.60	4.23	5.76
11	5.22	3.70	5.60
12	3.42	3.56	6.10
13	3.17	4.12	5.39
14	3.65	5.64	4.56
Mean	3.33	3.74	4.08

FIG. 4.17. FORTNIGHTLY FEED CONVERSION EFFICIENCY OF LIGHT WEANERS



treatment the feed conversion efficiency was seen steady from first to seventh fortnight (2.87 to 3.23) and then a reduction in feed conversion efficiency upto 14th fortnight.

As a whole the mean feed conversion efficiency of light weaners was highest in the order of HP (3.33 ± 0.524), NRC (3.72 ± 0.271) and LP (4.08 ± 0.903). (Table 4.27) Comparison between treatments was done by t - test and shows highly significant difference between HP and LP but shows no significant difference between other treatments.

Table 4.27. Comparison of feed conversion efficiency of Light Weaners

Groups	Means		t-value
Treatment I (HP) x Treatment II(NRC)	3.33±0.524	3.72±0.271	1.8118 NS
Treatment I (HP) x Treatment III (LP)	3.33±0.524	4.08±0.903	3.3044 **
Treatment II (NRC) x Treatment III (LP)	3.72±0.271	4.08±0.903	1.1899 NS

** Significant at 1 per cent.

NS Non-significant

Table 4.28 presents the comparisons between heavy and light weaners for the three treatments upto 10 fortnight. The result of analysis shows a significant difference between weaner weight groups in treatment II and III. In general, lighter-weaned pigs had significantly ($P< 0.05$) higher feed efficiency in these treatments. In the case of treatment I also a similar trend was observed eventhough the difference were not significant.

Table 4.28. Comparison of feed conversion efficiency from first to 10th fortnight

Treatment	Heavy Weaners	Light Weaners	t-value
I [HP]	3.48±0.453	3.11±0.492	2.2868 NS
II [NRC]	4.02±0.383	3.51±0.161	2.3836 *
III [LP]	5.18±0.675	3.55±0.746	3.0763 *

* Significant at 5 per cent.

NS Non-Significant

4.12. Correlation co-efficient

4.12.1 Heavy weaners

The co-efficient of correlation between average weight gain and average feed intake for three treatments of heavy weaners are presented in Table 4.29. The result shows a significant correlation in treatment I and II and,

a high significance in treatment III.

Table 4.29. Correlation between weight gain and feed intake of Heavy Weaners

Treatment	Weight gain (kg)	Feed intake (kg)	Correlation coefficient
I [HP]	3.62±0.218	12.70±2.139	0.645 *
II [NRC]	4.08±0.195	16.54±1.842	0.685 *
III [LP]	3.86±0.511	20.89±4.422	0.899 **

* Significant at 5 per cent.

** Significant at 1 per cent.

Table 4.30. Correlation between weight gain and feed conversion efficiency of Heavy Weaners

Treatment	Weight gain (kg)	Feed conversion efficiency	Correlation coefficient
I [HP]	3.62±0.218	3.48±0.453	0.336 NS
II [NRC]	4.08±0.195	4.02±0.383	0.304 NS
III [LP]	3.86±0.511	5.18±0.675	0.474 NS

NS Non-Significant

The correlation co-efficient between average weight gain and average feed conversion efficiency of heavy weaners when tested were found to be non-significant in all the treatments (Table 4.30).

The co-efficient of correlation of average feed intake on average feed conversion efficiency of heavy weaners are given in Table 4.31. and, were found to be highly significant in all the treatments

Table 4.31. Correlation between feed intake and feed conversion efficiency of Heavy Weaners

Treatment	Feed intake (kg)	Feed conversion efficiency	Correlation coefficient
I [HP]	12.70±2.139	3.48±0.453	0.935**
II [NRC]	16.54±1.842	4.02±0.383	0.900**
III [LP]	20.89±4.422	5.18±0.675	0.810**

** Significant at 1 per cent.

4.12.2 Light weaners

In the case of light weaners, the correlation co-efficient between average weight gain and average feed intake was found to be highly significant in all the three treatments (Table 4.32).

Table 4.32. Correlation between weight gain and feed intake of Light Weaners

Treatment	Weight gain (kg)	Feed intake (kg)	Correlation coefficient
I [HP]	3.87±0.981	13.13±3.939	0.891**
II [NRC]	4.42±0.599	16.88±2.929	0.916**
III [LP]	3.27±0.742	14.05±5.432	0.900**

** Significant at 1 per cent.

Table 4.33. Correlation between weight gain and feed conversion efficiency of Light Weaners

Treatment	Weight gain (kg)	Feed conversion efficiency	Correlation coefficient
I [HP]	3.87±0.981	3.33±0.524	0.181 NS
II [NRC]	4.42±0.599	3.72±0.271	0.465 NS
III [LP]	3.27±0.742	4.08±0.903	0.573*

* Significant at 5 per cent.

NS Non-Significant

Table 4.33 presented the correlation coefficient between average weight gain and feed conversion efficiency of light weaners. The correlation were found to be non-significant in all the treatment except in treatment III.

A highly significant correlation between average feed intake and average feed conversion efficiency were found in treatment II and III of light weaners. The first treatment also shows a significant correlation (Table 4.34).

Table 4.34. Correlation between feed intake and feed conversion efficiency of Light Weaners

Treatment	Feed intake (kg)	Feed conversion efficiency	Correlation coefficient
I [HP]	13.13±3.939	3.33±0.524	0.602 *
II [NRC]	16.88±2.929	3.72±0.271	0.779 **
III [LP]	14.05±5.432	4.08±0.903	0.867 **

* Significant at 5 per cent.

** Significant at 1 per cent.

4.13 Feed conversion efficiency from weaning to puberty

The average feed consumption (kg), weight gain (kg) and feed conversion efficiency of light and heavy weaner group from weaning to puberty for three treatments are given in Table 4.35 and Fig. 4.18.

4.13.1 Heavy weaners

In heavy weaners, treatment I shows the highest feed conversion efficiency (3.164) followed by treatment II (3.994), and treatment III have the lowest feed conversion efficiency (5.256). The feed conversion efficiency increased as the plane of feeding increased. The weight gain (30.13 kg) and feed intake (95.33 kg) of treatment I was lowest. A very high feed consumption was noticed in third treatment of heavy weaners (171.23 kg) whereas weight gain was comparatively low (32.58 kg) than treatment II (33.33 kg). The second treatment recorded the feed intake as 133.11 kg.

4.13.2 Light weaners

The light weaners shows the same trend in feed conversion efficiency as heavy weaners. The highest feed conversion efficiency was found in treatment I (3.325) followed by treatment II (3.594) and lowest in treatment III (4.022). The feed consumption in treatment I, II and III were 144.06, 180.93 and 181.01 kg respectively. The

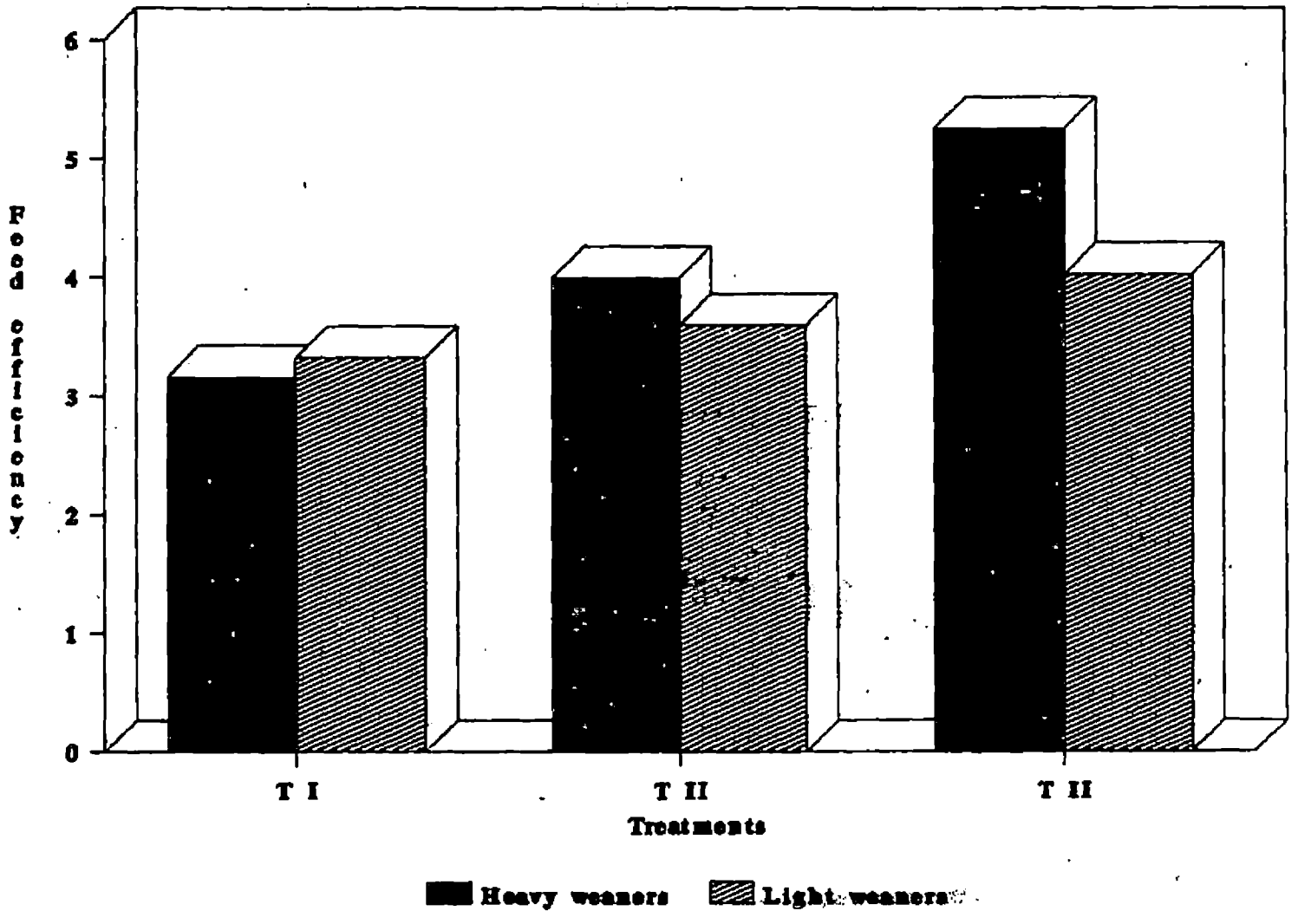
weight gain was highest in NRC (50.34 kg) followed by treatment III (45.00 kg) and lowest in treatment I (43.33 kg).

The feed intake was found to be highest in the order of treatment III, II and I in both light and heavy weaners. The lowest weight gain was recorded in first treatment in both the groups.

Table 4.35. Feed conversion efficiency from Weaning to Puberty

Group	Treatment	Feed consumed (kg)	Weight gain (kg)	Feed per kg gain
Heavy Weaners	I [HP]	95.330	30.130	1:3.164
	II [NRC]	133.110	33.330	1:3.994
	III [LP]	171.230	32.580	1:5.256
Light Weaners	I [HP]	144.060	43.330	1:3.325
	II [NRC]	180.930	50.340	1:3.594
	III [LP]	181.010	45.000	1:4.022

FIG.4.18. FEED CONVERSION EFFICIENCY FROM WEANING TO PUBERTY



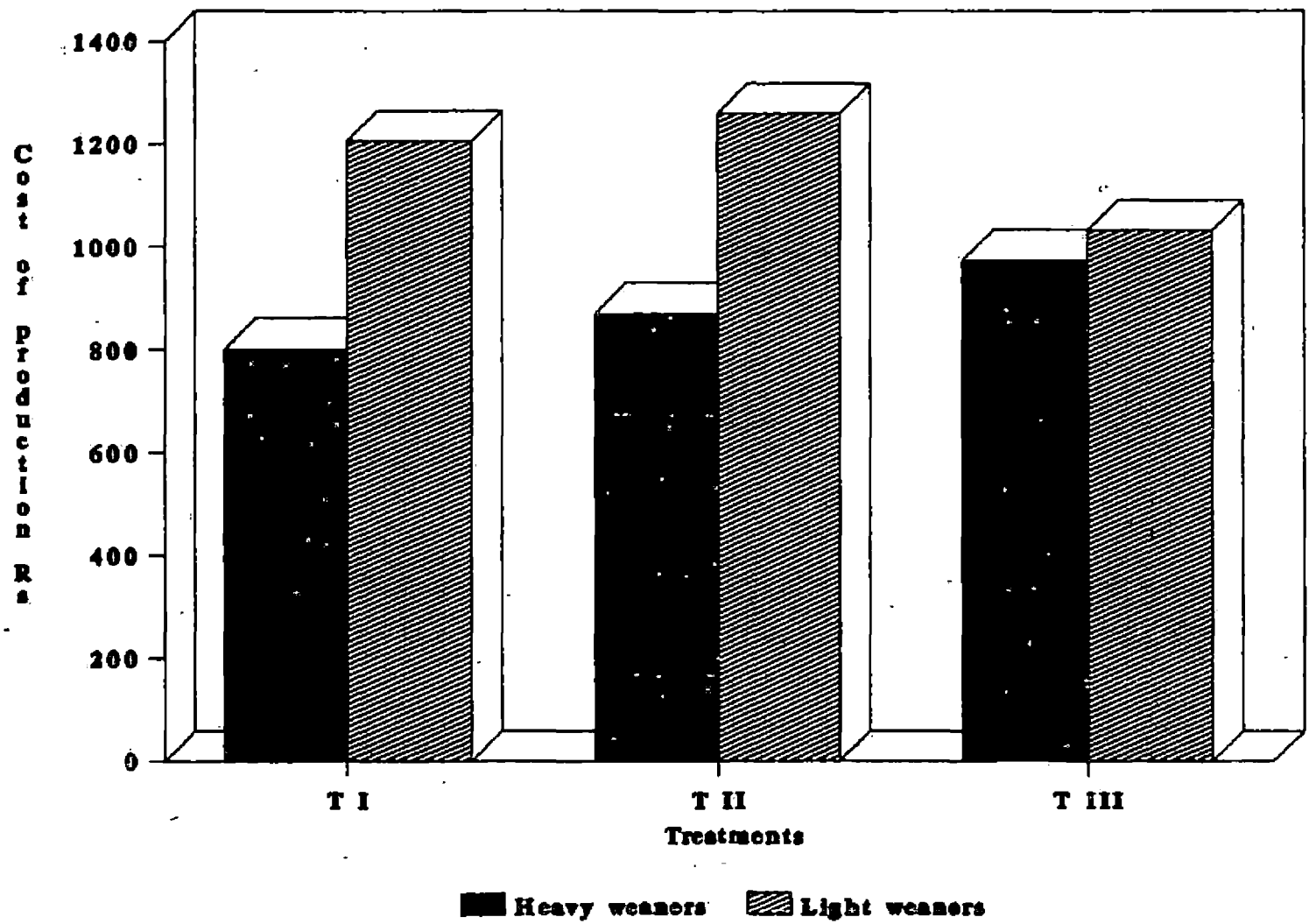
4.14 Cost of production

Table 4.36. shows the average feed consumption at different stages of body weight, total feed consumption, cost of feed, weight gain and cost of production per gilt (Fig. 4.19) and cost per kg gain from weaning to puberty of light and heavy weaners.

Table 4.36. Cost of production per pig from Weaning to Puberty

Age group	Feed consumed (kg)					
	Heavy Weaners			Light Weaners		
	I [HP]	II [NRC]	III [LP]	I [HP]	II [NRC]	III [LP]
Weaning to 20 kg	21.18	19.86	22.62	32.39	40.50	34.18
21 to 35 kg	50.01	60.76	99.71	47.42	52.65	60.77
36 kg to puberty	24.14	52.49	48.90	64.25	87.78	86.06
Total feed consumed kg	95.33	133.11	171.23	144.06	180.93	181.01
Cost of feed Rs.	602.16	692.12	731.03	905.29	944.51	774.13
Average weight gain kg	30.13	33.33	32.59	43.33	50.34	45.00
Cost of production Rs.	802.88	922.83	974.71	1207.05	1259.35	1032.18
Cost per kg gain Rs.	26.65	27.69	29.91	27.86	25.02	22.94

FIG.4.19. COST OF PRODUCTION PER PIG FROM WEANING TO PUBERTY



4.14.1 Heavy weaners

The heavy weaners receiving treatment I recorded the feed intake of 21.18 kg upto 20 kg body weight, 50.01 kg from 21 to 35 kg body weight and 24.14 kg from 36 kg body weight to puberty. In the case of treatment II, it was recorded as 19.86, 60.76 and 52.49 kg feed intake at different stages from weaning to puberty. For treatment III the same was recorded as 22.62, 99.71 and 48.90 kg respectively.

The total feed consumption upto puberty for treatment I, II and III were 95.33, 133.11 and 171.23 kg with the cost of Rs. 602.16, Rs. 692.12 and Rs. 731.03 respectively.

The average gain within this period were recorded as 30.13, 33.33 and 32.59 kg in treatment I, II and III respectively. The cost of production was least in treatment I (Rs. 802.88) followed by second treatment (Rs. 922.83) and highest in treatment III (Rs. 974.71).

The cost per kg gain in heavy weaners was highest in treatment III (Rs. 29.91) and lowest in treatment I (Rs. 26.65) followed by treatment II (Rs. 27.69).

4.14.2 Light weaners

In the light weaners, treatment I consumed 32.39

kg from weaning to 20 kg body weight, 47.42 kg from 21 to 35 kg body weight and thereafter 64.25 kg upto puberty. In the case of treatment II, the same was recorded as 40.50, 52.65 and 87.78 kg respectively. For the third treatment, feed consumption at different stages of growth upto puberty are recorded as 34.18, 60.77 and 86.06 kg respectively.

The total feed required to attain puberty in treatment I, II and III were 144.06, 180.93 and 181.01 kg with the cost of Rs. 905.29, Rs. 944.51 and Rs. 774.13 respectively for light weaners.

The average gain from weaning to puberty in treatment I, II and III was recorded as 43.33, 50.34 and 45.00 kg respectively. The cost of production per gilts upto puberty was found to be highest in treatment II (Rs. 1259.35) followed by treatment I (Rs. 1207.05) and lowest in treatment III (Rs. 1032.18).

In the light weaners, cost per kg gain was recorded Rs. 27.86, Rs. 25.02 and Rs. 22.94 respectively in treatment I, treatment II and treatment III.

Discussion

5 DISCUSSION

The recording of body weight and feed intake of heavy weaners continued from weaning to 10th fortnight as against the light weaners in which the body weight was recorded from weaning upto 14th fortnight.

5.1 Body weight of pigs

Growth represented by increase in body weight with age is of great economic importance as it is the basis on which other forms of production like meat, milk, etc., depends.

5.1.1 Heavy weaners

The fortnightly body weight of HP group recorded an increase from 12.00 $\pm$ 0.585 kg to 48.13 $\pm$ 0.815 kg, representing a total gain of 36.13 kg. In the case of NRC group, the body weight increased from 12.00 $\pm$ 0.429 kg to 52.83 $\pm$ 5.548 kg giving a total gain of 40.83 kg. The body weight in LP group recorded 12.08 $\pm$ 0.449 kg to 50.67 $\pm$ 3.927 kg giving a total gain of 38.59 kg.

The NRC group of animals recorded 4.7 kg and 2.24 kg more than HP and LP group respectively. The body weight gain has recorded a decreasing tendency as the dietary

energy and protein levels were increased. Eventhough the fortnightly body weight of NRC group was more than that of the other two treatments, the difference was found to be non-significant.

The animals in all the treatments showed a progressive increase in weight from weaning to 10th fortnight.

5.1.2 Light weaners

The fortnightly body weight of light weaners in HP group recorded an increase from 7.67 ± 0.543 kg to 61.83 ± 3.164 kg from weaning to 14th fortnight. In the case of NRC group, the body weight increased from 8.08 ± 0.216 kg to 70.00 ± 4.621 kg. In the LP group, the same showed an increase from 8.50 ± 0.707 kg to 54.25 ± 5.480 kg.

The highest total gain in weight was noticed in the case of NRC group (61.92 kg) followed by HP group (54.16 kg) and LP group (45.75 kg).

The NRC group of animals were 7.76 kg and 16.17 kg more in weight than HP group and LP group of animals respectively, but the difference obtained in the body weight was found to be non-significant.

The higher body weight gain observed in NRC group of both heavy and light weaners could be due to the

supplementation of fat at a lower rate which resulted in increased weight gain. The HP group with higher density of dietary energy and protein showed a lower body weight gain than the NRC which may be due to high rate of fat (>5%) incorporated in the diet. The above finding is in agreement with the report of Polikarpov (1981) and Maeng et al. (1990) who had reported an increased body weight gain on less than 5% fat supplemental diet and reduced weight gain in pigs fed more than 5% dietary fat.

The light weaners also showed a progressive increase in body weight from weaning to 14th fortnight.

The result obtained in both heavy and light weaners indicated that HP diet is having a depressing effect on the body weight of the animals. This may be due to high percentage of fat (>5%) in the ration to increase the energy level. This finding is in line with the report of Leibbrandt et al. (1975) who have also noted a decreased total weight gain in pigs fed diet containing fat from 5 to 10 per cent.

The nature of growth in both the groups are in agreement with the pattern of growth reported by Brody (1945) and Maynard et al. (1979).

The present finding is also in agreement with that of Saseendran (1979), Leena (1992) and Sabastian (1992) in

which they have reported a progressive increase of body weight from weaning to subsequent weight.

The average fortnightly weight recorded in the present study is less than the body weight reported by Saseendran (1979) and Leena (1992) in Large White Yorkshire. But the result of the present study is higher than the report of Sabastian (1992) in case of piglets born in wet season and, further reported a higher body weight than the present study in animals born in dry season, at 10th fortnight.

The body weight at fourth and sixth fortnight recorded in heavy weaners are higher than that reported by Gupta (1983), but the light weaners weight was found to be lower in the present study.

The report of Sharma et al. (1990) in Large White Yorkshire and, Lakhani and Bhadoria (1991) in indigenous pigs were found to be lower than the report of the present study.

The growth curve of heavy and light weaners (Fig. 4.3) remained parallel throughout for the period of 10 fortnight, indicating that light weaners are not making any compensatory gain. McConnell et al. (1987) made similar observations.

5.2 Rate of growth

5.2.1 Heavy weaners

The average fortnightly rate of growth increase gradually from first fortnight.

In the HP group, the rate of growth reached peak at ninth fortnight (4.38 ± 0.622 kg) followed by reduction in growth rate at 10th fortnight. The NRC group recorded a higher growth rate which increased from first fortnight (3.50 ± 0.373 kg) to a peak of 4.83 ± 0.723 kg in sixth fortnight, followed by decreased growth rate and come to peak at ninth fortnight (4.50 ± 0.612 kg). The rate of growth in LP group was comparatively lower till seventh fortnight and thereafter it increased even better than both the other treatment groups. The peak growth rate was observed by about ninth fortnight (5.92 ± 0.594 kg). The difference in the rate of growth during every fortnight was found to be non-significant.

The fortnightly weight gain when taken on the whole was found to be 3.62 ± 0.218, 4.08 ± 0.195 and 3.86 ± 0.511 in HP, NRC and LP group respectively. The variation between HP and LP and, between NRC and LP was found to be non-significant (Table 4.4). This is in agreement with the reports of previous workers (Tribble and Ramsey, 1970; Phuah and Hatagalung, 1979; Barbosa *et*

al., 1982; Reddy et al., 1982; Sharda et al., 1982) who could not find any significant difference in growth rate due to different dietary protein levels. The NRC group was found to have significantly higher ($P < 0.05$) growth rate than HP group. This is consistent with the report of Morris et al. (1976) who observed maximum growth performance in control than in higher or lower dietary energy groups.

5.2.2 Light weaners

The average fortnightly rate of growth increased from first fortnight (2.00 ± 0.000kg) to a peak by 13th fortnight (8.00 ± 1.080 kg) and then reduced to 6.67 ± 1.298 kg (14th fortnight) in the HP group. In the case of NRC group, the rate of growth increased from 2.58 ± 0.274 kg to 7.08 ± 0.362 kg from first to 12th fortnight and then gradually reduced to 5.08 ± 0.432 kg by 14th fortnight. The LP group recorded a growth rate of 2.00 ± 0.354 kg to 6.00 ± 0.000 kg. The variation recorded from first to 14th fortnight showed non-significant difference between treatment group except in the 12th fortnight where NRC group gain significantly higher ($P < 0.05$), coinciding with the onset of puberty.

The fortnightly weight gain on the whole was found to be 3.87 ± 0.981 kg, 4.42 ± 0.990 kg, and 3.27 ± 0.742 kg respectively in HP, NRC and LP group. The variation in

growth rate between HP and NRC group was found to be non-significant (Table 4.6). This finding is in agreement with the report of Feng et al. (1985) where non-significant difference in gain between high and intermediate dietary energy and protein group was reported. The growth rate of LP group was found to be significantly lower than HP ($P < 0.05$) and NRC group ($P < 0.01$). Stahley and Wahlstrom (1973), Cromwell et al. (1978), Metz et al. (1980), Campbell and Dunkin (1983) and Campbell and Taverner (1986) made similar observations.

The growth rates obtained in both light and heavy weaners in the present study are much more than the report of Saseendran (1979) in indigenous pig. The present result is comparable to the report of Sabastian (1992) in which it is noted that the average fortnightly rate of growth as 3.1 to 4.5 kg in NRC group and 3.8 to 4.2 kg in the case of low plane in wet season.

Campbell et al. (1975), Metz et al. (1980), Campbell and Dunkin (1983), Kuan et al. (1986) and Zhang et al. (1986) have reported an increased growth rate with increasing dietary energy intake which is in variance with the present report of both heavy and light weaners in the case of HP group. The low growth rate observed in HP group may be probably due to the reduced ability of pigs to

digest fat (Kitts et al., 1956; Lloyd, et al., 1957 and Schench et al., 1992) where high rate of fat was added in HP diet to increase the energy level.

A better growth rate is recorded in heavy weaners (4.08 ± 0.195 kg) than light weaners (3.00 ± 0.260 kg) when fed NRC diet but the variation in growth rate was found to be non-significant (Table 4.7). The heavy weaners recorded a significantly high growth rate ($P < 0.05$) in case of HP (3.62 ± 0.218 vs 3.00 ± 0.260 kg) and in LP group ($P < 0.01$) than the light weaners (3.86 ± 0.511 vs 2.75 ± 0.276 kg). The above observation is in agreement with the report of Fowler and Boaz (1963) and Rodriguez (1982) who have stated that light weaners takes longer time to reach 130 lb. live weight and gain lesser than heavy weaners. The present study is in variance with the report of Csire (1965) and Mahendranathan (1973). They have reported a non-significant difference in weight gain in pigs weaned at different body weight.

In heavy weaners, the average rate of growth came to peak by ninth fortnight and in light weaners by 12th to 14th fortnight which coincides with the onset of puberty as was explained by Brody (1945).

5.3 Absolute weight gain

5.3.1 Heavy weaners

The absolute weight gain of HP group showed a gradual increase from first (232 g) to ninth fortnight (313 g) with a slight decrease in sixth, seventh and eight fortnight. In the case of NRC, it follows the same trend as HP from first (250 g) to sixth fortnight (345 g), then declines at seventh and eighth fortnight and reached the peak at ninth fortnight (321 g). The LP group showed almost a similar pattern from first (241 g) to ninth fortnight(432 g). The mean absolute gain observed in the present study are 258.1 g, 291.5 g and 275.1 g respectively in HP, NRC and LP group. The peak gain observed in the ninth fortnight is in agreement with the report of Leena (1992).

5.3.2 Light weaners

The absolute weight gain showed a gradual increase from first (143 g) to seventh fortnight (238 g) followed by decreased gain at eighth, ninth and 10th fortnight, then gradually increased to 13th fortnight (571 g). The NRC group gained linearly from first (185 g) to 12th fortnight (506 g) with decreased gain at second fortnight (166 g). The LP group of animals showed an increased gain from first (143 g) to 14th fortnight (429 g) with a mild decrease in gain at sixth fortnight. The average gain

recorded are 276.21, 315.79 and 233.36 g in HP, NRC and LP group respectively.

The pattern of gain obtained in the case of light weaners is in agreement with the report of Baran (1991) who had noted a reduced daily gain on 15 per cent energy and protein restriction and in variance with the report of Friend (1977 b) who had reported a significantly higher rate of body weight gain on increasing dietary energy and protein content.

The daily gain reported in the present study in both heavy and light weaners are lower than the report of previous workers (Sarma et al., 1977; Wahlstrom and Libal, 1977; Saseendran, 1979; Angelova et al., 1985; Maricic et al., 1986; Sikka and Mehta, 1986; Leena, 1992 and Sabastian, 1992), but higher than the report of Mukhopadhyay et al. (1991).

Increased daily gain with increasing dietary protein level was reported by Boka (1972), Gilster and Wahlstrom (1973), Rodriguez et al. (1982), Fuchs (1984) and Podletskaya et al. (1988) which are in variance with the present report as the NRC group gain higher than the other treatment groups in both heavy and light weaners. The higher gain observed in NRC group is in agreement with the report of Waterman et al. (1973). They have reported

that pigs fed on low levels of supplemental fat in their ration gained faster and required less amount of metabolizable energy per unit gain.

5.4 Percentage of growth rate

The growth rate expressed as percentage of previous fortnight's weight was maximum in the first fortnight and gradually decline as the age advanced in heavy (Table 4.10, Fig. 4.8) and light weaners (Table 4.11, Fig. 4.9) of all treatment groups.

The heavy weaners showed a temporary increase in the percentage of growth rate by ninth fortnight in HP and NRC group. In the case of LP group it was noticed in eighth fortnight.

The light weaners exhibited an irregular percentage of growth rate in which the values were found to increase temporarily from 10th fortnight in HP, 11th fortnight in NRC and 12th fortnight in the case of LP group.

The result obtained is in accordance with that reported by Leena (1992).

The pattern of growth in terms of body weight, rate of growth and absolute gain in the present study is similar to that of other farm animals (Rajagopalan, 1974).

The faster rate of growth observed in heavy weaners and lesser in light weaners is in agreement with the report of Rodriguez (1982), Himmelberg et al. (1985) and Yen et al. (1989).They have reported that heavy weaners eat more and gain faster than the light weaners.

5.5 Age and weight at puberty

5.5.1 Heavy weaners

The HP, NRC and LP group recorded the onset of puberty at 180.50 ± 3.580, 182.00 ± 10.720 and 188.33 ± 12.230 days with an average body weight of 42.13 ± 1.095, 45.33 ± 2.119 and 44.67 ± 1.527 kg respectively. The variation in age and body weight between treatments were found to be non-significant.

The HP group of animals attained puberty 1.5 and 7.83 days earlier than NRC and LP group respectively but, the body weight was found to be 3.2 and 2.54 kg lower than NRC and LP group respectively. The above report is consistent to the report of Salmon - Legagneur (1971) who had reported a lighter (106 vs 118 kg) weight and younger age (246 vs 280 days) at puberty on high plane of nutrition.

5.5.2 Light weaners

The light weaners recorded the age at puberty as 233.33 ± 1.440, 229.83 ± 6.034 and 254.00 ± 19.090 days in

HP, NRC and LP groups. The corresponding body weight was recorded as 51.00 ± 2.494, 58.42 ± 3.201 and 53.50 ± 1.750 kg respectively. The variation in age and weight at puberty between treatments were found to be non-significant.

At puberty, the NRC group of light weaners were 3.5 days younger than HP group and 24.17 days younger than those of LP group. The body weight of NRC was found to be 7.42 kg and 4.92 kg higher than HP and LP group respectively at puberty.

Friend (1977 a) explained that reduced feed intake and / or deterioration of fat in diet as a possible cause of delayed puberty as a result of suppressed hypothalamic activity. Duncan and Lodge (1960) also suggested that over feeding may inhibit the onset of puberty. These explanations may be the reason for delayed puberty in HP group of light weaners in which fat was incorporated at high rate to make up the energy level and reduced ability to digest fat in early post-weaning period (Kitts *et al.*, 1956) which ultimately affect the growth rate and subsequently on puberty onset.

On statistical analysis the present study shows that plane of feeding adopted does not have significant effect on age and weight at puberty in both light and

heavy weaners. The findings are in agreement with the reports of Baker et al. (1958), Gossett and Sorensen (1959), Sorensen et al. (1961), Cunningham et al. (1974), Aherne et al. (1976), Friend (1977 b), Schilling and Schroder (1978), Friend et al. (1979), Friend et al. (1981) and Koczanowski et al. (1993).

In the present study, animals on low plane diet of heavy and light weaners attained puberty at a later age which is in agreement to the report of Goode et al. (1960), Holness (1973) and, Newton and Mahan (1992). But the body weight of LP group was higher at puberty than HP group. This indicated that the digestible energy of LP diet was sufficient for the observed growth rate (Hughes and Varley, 1980) and the feed intake was more in this LP group.

The body weight at puberty reported by Mahendranathan and Mellish (1975) in local Chinese gilts (48.7 kg) and, Mahanty and Nayak (1986) in Large White Yorkshire (37.3 kg) are comparable to the present report.

Irrespective of body weight at weaning the animals on low plane of nutrition was found to increase the age at puberty which is consistent to the report of Hartog and Noordewier (1985) and, Aherne and Kirkwood (1985). They have reported a delayed puberty on protein and energy

restriction.

In case of light weaners, HP diet did not enhance the onset of puberty as observed in the case of heavy weaners. This shows that higher plane of feeding did not have supportive effect on the attainment of puberty when weaning weight is low.

The light weaners on an average takes significantly longer ($P< 0.01$) time to reach puberty (235.18 $\pm$ 5.783 days) as against the heavy weaners (184.00 $\pm$ 6.428 days) but light weaners were significantly heavier ($P< 0.01$) at puberty (55.50 $\pm$ 2.276 vs 44.28 $\pm$ 1.100 kg). This is in agreement with the report of Krieter and Kalm (1990) who had noted that animals that grew rapidly during the early growing period matured earlier and have a smaller mature size than slow growing pigs. Phillips and Zeller (1943) also reported that faster growing animals mature earlier due to higher level of pituitary activity.

During the course of the experiment 66.67 % of low plane group in light weaners did not attain puberty even after nine months of age. This implies that pigs of low weaning weight fed with low plane diet are not advisable for economic rearing of pigs.

5.6 Length of oestrous cycle and oestrous period

The oestrous cycle length of heavy weaners

recorded in HP, NRC and LP group are 21.00 ±0.790, 20.00 ± 0.335 and 19.83 ± 0.282 days respectively. The same in the light weaners are 21.00 ± 0.814, 20.33 ± 0.384 and 19.50 ± 0.354 days. The variation of oestrous cycle length was found to be non-significant between treatments. The result also showed that there was no significant difference between heavy and light weaners (Table 4.13.1).

As the plane of feeding increase, the oestrous cycle tend to be longer. In the heavy weaners, the difference of the cycle length of HP and LP is 1.17 days whereas in light weaners, it is 1.50 days.

The length of oestrous cycle reported in the present study is in accordance with the report of Pastavalau and Shkunkova (1981) in which a longer oestrous cycle on increased dietary energy was reported. Rozeboom *et al*. (1993) had noticed a longer oestrous cycle on severe energy restriction (21.0 ± 0.2 vs 20.2 ± 0.3 days) which is in variance with the present report.

The oestrous cycle length in the present study ranged from 19.5 to 21.0 days irrespective of treatments and groups. The values are in agreement with the report of previous workers (Dyck, 1971; Bundy *et al*. 1976; Tsiganchuk, 1976; Hughes and Varley, 1980; Anderson and Karlbom, 1982; Fan *et al*., 1982; Mohanty and Nayak, 1986

and Hafez, 1987).

The first oestrous period of heavy weaners in HP, NRC and LP group recorded are 39.00 ± 3.355, 42.00 ± 2.000 and 46.00 ± 2.311 hour respectively. The same in the case of light weaners are 38.00 ± 4.319, 41.00 ± 2.200 and 45.00 ± 2.121 hour respectively. The oestrous periods were found to be unaffected by the plane of feeding and weight at weaning as the variations were non-significant.

The duration of oestrus is in agreement with the report of Danilov (1972), Steinbach (1973), Tsiganchuk (1976), Bendrijfsontwikkeling (1977), Hughes and Varley (1980) and Hafez (1987) but found to be shorter than the reports of Fan et al. (1982) and Mahanty and Nayak (1986) who have recorded as 7 days and 72.4 hour respectively.

The second oestrous period of heavy weaners recorded are 51.00 ± 3.335, 56.00 ± 2.311 and 67.00 ± 2.200 hour in HP, NRC and LP group respectively. The variation due to treatment was found to be highly significant ($P < 0.01$) but found to be non-significant between heavy and light weaners. In the case of light weaners, the same was recorded as 46.67 ± 4.752, 54.00 ± 2.000 and 66.00 ± 4.243 hour respectively. The difference was found to be non-significant.

In both heavy and light weaners, the first oestrous period was found to be shorter than the second oestrus in all the treatments which is in agreement with Hafez (1987).

5.7 Oestrous behaviour

The intensity of oestrous behaviour was scored in pigs in all the treatments. The observed scores in HP, NRC and LP group are 1.33 ± 0.120, 2.02 ± 0.163 and 2.85 ± 0.069 respectively in heavy weaners and 1.40 ± 0.64, 2.30 ± 0.184 and 3.08 ± 0.092 respectively in the case of light weaners. The variation was found to be highly significant ($P< 0.01$) between treatments. The lower score or less intensity of oestrous behaviour observed in HP group of both heavy and light weaners may be due to increase plasma estrogen clearance on high energy intake as was explained by Kirkwood and Aherne (1985).

The present observation is also in agreement with the report of Mathew (1992) in which a lower score of oestrous behaviour in high plane group than low plane was reported

5.8 Feed intake

5.8.1 Heavy weaners

The average daily feed intake taken at fortnightly intervals was found to increase gradually from first to

10th fortnight. In HP group, the daily feed intake ranged from 0.595 kg to 1.510kg with a mild decrease during sixth, seventh and eighth fortnight. The NRC group shows the same trend from 0.651 kg to 1.560 kg with a mild reduction in seventh fortnight. In the case of LP group, daily feed intake recorded from 0.602 kg to 2.518 kg during 10th fortnight. In all the three treatments, the trend was same when the feed intake was taken at fortnightly intervals (Table 4.19).

The average fortnightly feed intake of HP group (12.70 $\pm$ 2.139 kg) was found to be significantly lower ($P< 0.01$) than NRC (16.54 $\pm$ 1.842 kg) and LP group (20.89 $\pm$ 4.422 kg).The plane of feeding in the present study have no significant effect on feed intake between NRC and LP group of heavy weaners (Table 4.20).

5.8.2 Light weaners

The feed intake of HP group gradually increase from 0.389 kg in the first fortnight to 1.809 kg in 13th fortnight with a mild decrease in seventh and 12th fortnight. Same is the trend in the case of NRC group which range from 0.604 kg to 2.048 kg from first to 14th fortnight with less feed intake during second fortnight. In the case of LP group, the daily feed intake recorded a gradual increase from 0.409 to 1.954 kg from first to 14th fortnight with decreased intake during sixth and seventh

fortnight. The feed intake when taken at fortnightly interval showed the same trend as the average daily feed intake (Table 4.21).

On the whole, the HP group showed a comparatively low feed intake (13.13 ± 3.939 kg) than NRC (16.88 ± 2.929 kg) and LP group (14.05 ± 5.432 kg). The result of the present study shows that feed intake of NRC group was significantlly higher ($P < 0.01$) than the other two treatments, but the variation between HP and LP group was found to be non-significant (Table 4.22).

The reduction in feed intake of both heavy and light weaners during the study may be due to change of feed when the animals reach a certain body weight and, inclusion of dietary fat. This might have reduced the appetite and ultimately reduced the feed intake. The quick return to normal feed intake once freshly prepared feed was offered indicated that deterioration of some kind had taken place to which the pigs were specifically sensitive.

In the present study, the feed intake reduced as the dietary energy level increased in both heavy and light weaners. This is in agreement with the earlier reports of Morris et al. (1976), O'Grady (1978), Chung et al. (1986) and Zhang et al. (1986).

A non-significant difference between different plane of feeding on feed intake was reported by Sarma et al. (1977), Barbosa et al. (1982) and Reddy et al. (1982) which is in variance with the present study where plane of feeding has a highly significant ($P< 0.01$) effect on feed intake, except between NRC and LP group of heavy weaners (Table 4.20) and between HP and LP group of light weaners (Table 4.22).

The feed intake of heavy weaners with LP diet was found to be comparatively high from sixth fortnight. This could be partly for compensating the protein consumption during the later part of the experimental diet as suggested by Irvin et al. (1975).

The fortnightly feed intake of heavy weaners recorded in the present study is significantly ($P< 0.01$) higher than the light weaners in all the treatments (Table 4.23). This finding is in accordance with the reports of Gajic (1971), Rodriguez (1982) and Himmelberg et al. (1985). They have reported that heavy weaners ate more than the light weaners to support their heavier body weight.

5.9 Feed conversion efficiency

5.9.1 Heavy weaners

The fortnightly feed conversion efficiency was

found to be most efficient in first fortnight. Recorded values are 2.56, 2.61 and 2.81 kg of feed / kg gain respectively in HP, NRC and LP group. With the exception of slight increase in feed efficiency at seventh fortnight in HP group and, at sixth, ninth and 10th fortnight in NRC group, they showed a gradual decreasing tendency till 10th fortnight. In the case of LP group, the feed efficiency decline gradually till seventh fortnight and thereafter shows a slight increase in feed efficiency upto 10th fortnight. The mean fortnightly feed conversion efficiency in HP, NRC and LP group are 3.48, 4.02 and 5.18 respectively.

The LP group of animals were significantly ($P< 0.01$) less efficient in feed conversion than HP and NRC group. Though HP group shows higher feed conversion efficiency, the variation to NRC group was found to be non-significant which is in agreement with the report of Feng et al. (1985) who had reported a non-significant difference between high and intermediate energy and protein level on feed conversion efficiency.

The fortnightly weight gain in HP, NRC and LP group are 3.62 ± 0.218, 4.08 ± 0.195 and 3.86 ± 0.511 kg respectively with the fortnightly feed intake of 12.70 ± 2.139, 16.54 ± 1.842 and 20.89 ± 4.422 kg respectively.

The correlation coefficient between weight gain and feed intake (Table 4.29) was found to be significant ($P< 0.05$) in HP and NRC group and, highly significant correlation ($P< 0.01$) in LP group indicating that there is a strong association between weight gain and feed intake. The weight gain was not found to be correlated with feed conversion efficiency. This finding is in agreement with the report of Headley (1946) and Magee (1962). The present study shows a significant correlation ($P< 0.01$) between average feed intake and feed conversion efficiency (Table 4.31) which is consistent with the report by Magee (1962).

5.9.2 Light weaners

The highest feed conversion efficiency was observed in third fortnight in both HP (2.36) and NRC (3.05) group. The feed efficiency gradually decrease till 11th fortnight and thereafter shows an improved feed efficiency in HP group. In the case of NRC group, the feed efficiency decline gradually till 14th fortnight but shows an increased efficiency at ninth, 11th and 12th fortnight. The LP group recorded the highest feed conversion efficiency (2.87) in first and fourth fortnight and then decline till 12th fortnight and shows a better feed efficiency at 13th and 14th fortnight. The mean fortnightly feed conversion efficiency are 3.33, 3.74 and

4.08 kg of feed / kg gain in HP, NRC and LP group respectively.

The fortnightly weight gain in HP, NRC and LP group are 3.87, 4.42 and 3.27 respectively with the corresponding feed intake of 13.13, 16.88 and 14.05 kg.

The weight gain was found to be highly correlated ($P< 0.01$) with feed intake in all the treatments indicating that there is a strong association between weight gain and feed intake (Table 4.32). The correlation coefficient of weight gain and feed conversion efficiency was found to be non-significant in HP and NRC group and found to be significant ($P< 0.05$) in LP group (Table 4.33). The feed intake and feed conversion efficiency was significantly correlated ($P< 0.05$) in HP group and highly correlated ($P< 0.01$) in NRC and LP group (Table 4.34).

The feed conversion efficiency was higher in both heavy and light weaners during the early period. This is in agreement with the reports of Blair et al. (1969), Cole et al. (1969) and Pay et al. (1973) who observed significantly higher feed efficiency during the early growth period. An improved feed conversion efficiency noticed at the later stage of growth probably be due to higher growth rate or reduced feed intake reported during

the period.

The present study shows that as the level of dietary energy and protein increase, the feed conversion efficiency increased in both heavy and light weaners. This is in accordance with the findings of several workers (Boka, 1972; Gilster and Wahlstrom, 1973; O'Grady, 1978; Gamko, 1983; Christon, 1984; Panaiotov et al., 1985; Kuan et al., 1986; Maricic et al.,1986; Campbell and Taverner, 1986; Zhang et al; 1986 and Bao et al., 1987).

Some workers reported a non-significant difference in feed conversion efficiency due to different levels of dietary energy and protein (Reddy et al, 1982) or with different protein levels (Barbosa et al., 1982) and others found a similar feed efficiency with different levels of protein (Tribble and Ramsey, 1970).

The efficiency of feed conversion of light weaners are significantly higher ($P< 0.05$) than the heavy weaners in NRC and LP group. In HP diet, the light weaners are more efficient in feed conversion than heavy weaners but the variation was found to be non-significant (Table 4.28). The above result is in accordance with the report of Fowler and Boaz (1963) who had noticed a better feed conversion efficiency in light weaners on both generous and restricted level of feeding. Gajic (1971) and Vasilev

(1972) reported a higher feed efficiency on heavy weaners which is in disagreement with the present study.

5.10 Feed conversion efficiency from weaning to puberty

5.10.1 Heavy weaners

From weaning to puberty, the HP group recorded the lowest total feed consumption (95.33 kg) and also the lowest total gain of 30.13 kg. In NRC group, feed intake recorded was 133.11 kg and shows the highest total gain (33.33 kg). The LP group of pigs consumed more feed (171.23 kg) than the other two treatments with a total gain of 32.58 kg.

The feed conversion was found to be most efficient in HP group (3.164) and least in LP group (5.256). In NRC group, the efficiency of feed conversion was found to be 3.994.

5.10.2 Light weaners

The total feed consumption of HP, NRC and LP group are 144.06, 180.93 and 181.01 kg with a total gain of 43.33, 50.34 and 45.00 kg respectively from weaning to puberty.

The feed conversion was found to be most efficient in HP group (3.325) followed by NRC group (3.594) and least in LP group (4.022).

The above report shows that as the level of energy and protein decreased, the feed intake increased. This is in agreement with the report of Noland and Scott (1960) and Rao et al. (1978).

In this present study, the feed conversion efficiency was found to be improved in both heavy and light weaners with increasing dietary energy and protein levels. The above report is in agreement with the report of Boka (1972), O'Grady (1978), Kuan et al. (1986) and Zhang et al. (1986).

Reddy et al. (1982) and Feng et al. (1985) reported a non-significant difference between different levels of dietary energy and protein whereas Tribble and Ramsey (1970) reported a similar feed efficiency in different dietary protein levels. The above reports are in variance with the present study.

The feed conversion efficiency of heavy and light weaners are found to be almost same in their respective treatment (Table 4.35). This finding is in agreement with the report of Csire (1965) in which no difference in feed conversion efficiency was noted between low, average and high body weight at weaning.

5.11 Economics of pig production

The cost of ration per kg at three different

stages of growth calculated were Rs. 7.00, Rs. 6.18 and Rs. 6.00 respectively in HP diet. Similarly, the cost of ration per kg in NRC recommended levels were Rs. 5.85, Rs.5.22 and 4.93. The same in LP diet were Rs. 4.83, Rs. 4.23 and Rs. 4.09 respectively.Presuming that the cost of feed represents 75 per cent of total cost of production (Krider and Carroll, 1971), the cost of production per gilt was calculated.

5.11.1 Heavy weaners

The total feed consumed from weaning to puberty in HP, NRC and LP group recorded in the present study are 95.33, 133.11 and 171.23 kg respectively with a total gain of 30.13, 33.33 and 32.59 kg. The cost of feed was found to be Rs. 602.16, Rs. 692.12 and Rs. 731.03 in HP, NRC and LP group respectively with the corresponding cost of production per gilt to reach puberty as Rs. 802.88, Rs. 922.83 and Rs. 974.71. The cost of production per kg gain was found to be cheapest in HP group (Rs. 26.65) followed by NRC group (Rs. 27.69) and highest in LP group (Rs. 29.91).

Eventhough the cost of ration per kg was cheapest for different stages of growth in LP group, cost per kg gain was found to be highest in LP group which may be due to low feed conversion efficiency and delayed puberty.

5.11.2 Light weaners

The total feed consumption to reach puberty recorded are 144.06, 180.93 and 181.01 kg in HP, NRC and LP group respectively with a total gain of 43.33, 50.34 and 45.00 kg. The cost of feed in HP, NRC and LP group are Rs. 905.29, Rs. 944.51 and Rs. 774.13 respectively with the corresponding cost of production per gilts to reach puberty as Rs. 1207.05, Rs.1259.35 and Rs.1032.18. The cost of production per kg gain was highest in HP group (Rs. 27.86) followed by NRC group (Rs. 25.02) and lowest in LP group (Rs. 22.94).

In light weaners, eventhough the cost of production per gilt to attain puberty and cost per kg gain are cheapest, it is not advisable as four out of six gilts did not attain puberty even after nine months of age. So in light weaners NRC recommended level of feeding is found to be most economic whereas in heavy weaners the high plane of feeding is found to have better performance in regard to attainment of puberty and cost of production.

From the above report, irrespective of the treatments, cost of production upto puberty is higher in light weaners than heavy weaners. The time taken to reach puberty is also longer in the case of light weaners.

Summary

6. SUMMARY

A study was carried out with 36 Large White Yorkshire weanling female pigs averaging 8 kg (light weaners) and 12 kg (heavy weaners) body weight and were grouped into two having 18 each of heavy weaners and light weaners. Pigs in each group was randomly assigned to three treatment groups of six pigs housed separately in lots of three each to have two observations. Each group was maintained on NRC recommended levels, a high plane (HP) of 10 per cent more than NRC and a low plane (LP) of 10 per cent less than NRC with regards to crude protein (CP) and digestible energy (DE) till the attainment of puberty and were fed ad libitum

The experiment was aimed to assess the effect of weight at weaning and plane of feeding on the onset of puberty in gilts, so as to minimise the cost of maintenance and maximise the net return from the pigs.

The fortnightly body weight, age and weight at puberty, oestrous cycle length, duration of oestrous period, feed consumption were noted and the oestrous behaviour was scored on the basis of ready- made scoring scale.

The animals on HP, NRC and LP gained 36.13, 40.83 and 38.59 kg respectively in heavy weaners in 10 fortnights. In light weaners the same was 54.16, 61.92 and 45.75 kg in 14 fortnights. Those animals on NRC level have the highest weight gain in both the groups but the variation in fortnightly body weight was non-significant.

Fortnightly and daily gain on NRC ration of heavy and light weaners were better than animals on HP or LP diet. The growth rate expressed as percentage of previous fortnight's weight was maximum during the first fortnight and decline gradually with advancing age in both the groups of all treatments.

The growth rate of heavy weaners was better than light weaners and significantly high on HP and LP diet but non-significant on NRC diet upto 10th fortnight.

The heavy weaners of HP, NRC and LP diet attained puberty at 180.50, 182.00 and 188.33 days respectively with the average body weight of 42.13, 45.33 and 44.67 kg. The age at puberty in the light weaners were 233.33, 229.83 and 254.00 days with the average weight of 51.00, 58.42 and 53.50 kg respectively. The plane of feeding reveals no significant difference on age and puberty but the pigs on LP diet tends to attain puberty later than HP or NRC in both the groups.

The heavy weaners attain puberty significantly earlier with a lighter weight than the light weaners. The plane of feeding has no significant effect on oestrous cycle length and oestrous period, although HP recorded longer oestrous cycle and shorter pubertal oestrous period in both heavy and light weaners. The second oestrous period in heavy weaners shows a significant difference. In both the groups, pubertal oestrus was shorter than second oestrous period.

The oestrous behavioural scores of heavy and light weaners due to plane of feeding shows a significant difference but between heavy and light weaners the scores are almost same.

The animals on HP were significantly consuming less feed than NRC or LP in heavy weaners. In light weaners NRC shows a significantly high feed intake than HP or LP group. The feed intake of heavy weaners upto 10th fortnight was significantly higher than light weaners in all the treatment groups.

The feed conversion efficiency was highest in HP and lowest in LP in both heavy and light weaners. The light weaners showed a better feed conversion efficiency than heavy weaners in their respective treatments.

From the above observations and inferences the animals maintained on HP diet of heavy weaners and light weaners on NRC diet are most economical..

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EFFECT OF WEIGHT AT WEANING AND PLANE OF FEEDING ON THE ONSET OF PUBERTY IN GILTS

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ABSTRACT

Thirty six Large White Yorkshire weanling females of 8 kg (light weaners) and 12 kg (heavy weaners) were randomly maintained on three different planes of feeding with respect to crude protein (CP) and digestible energy (DE) viz. (i) NRC recommended levels as control, (ii) a high plane (HP) of 10 per cent increase of CP and DE with respect to NRC level and (iii) a low plane (LP) of 10 per cent decrease of CP and DE with respect to NRC from weaning to puberty. The fortnightly and daily weight gain was higher in pigs fed NRC diet. The heavy weaners were having a better growth rate, daily gain, higher feed intake and attained puberty earlier than the light weaners, but the feed conversion efficiency was lower than light weaners. The heavy weaners on high plane attained puberty earlier than animals on NRC or low plane diet. In light weaners, NRC group attained puberty earlier than HP and LP group. In both heavy and light weaners, LP group attained puberty later than the other treatment groups. Plane of feeding has no significant effect on puberty attainment, oestrous cycle length and duration of pubertal oestrus but weight at weaning has a significant effect on the onset of puberty. Oestrous behaviour expressed as

scores was significantly affected by plane of feeding. The animals on high plane diet consumed less feed in both heavy and light weaners and have the highest feed conversion efficiency. The light weaners consumed feed comparatively lower and have better feed conversion efficiency than heavy weaners. The overall result suggested that heavy weaners on high plane diet are most efficient in feed conversion efficiency, economy and attainment of puberty at younger age. On the whole, the heavy weaners are more economical for replacement stock than light weaners.