COMPARATIVE EVALUATION OF LITTER TRAITS IN DESI, LARGE WHITE YORKSHIRE AND THEIR CROSSBRED PIGS

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By

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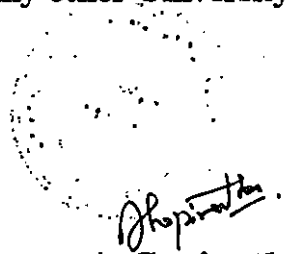
2001

DECLARATION

I hereby declare that this thesis entitled **"COMPARATIVE EVALUATION OF LITTER TRAITS IN DESI, LARGE WHITE YORKSHIRE AND THEIR CROSSBRED PIGS "** is a bonafide record of research work done by me during the course of research and that this 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



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CERTIFICATE

Certified that this thesis, entitled **"COMPARATIVE EVALUATION OF LITTER TRAITS IN DESI, LARGE WHITE YORKSHIRE AND THEIR CROSSBRED PIGS"** is a record of research work done independently by **Dr. A. Gopinathan,** under my guidance and supervision and that it has not previously formed the basis for the award of any degree, fellowship or associateship to him.

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Dedicated
to my
beloved parents

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Dr. A. Gopinathan

CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF PLATES

LIST OF ABBREVIATIONS

CP	Crude Protein
Kg	Kilo grams
ADG	Average Daily Gain
FCE	Feed Conversion Efficiency
Cm	Centimetres
Mm	Millimetres
AICRP	All India Co-ordinated Research project on pigs
CPPR	Centre for Pig Production Research

Introduction

1. INTRODUCTION

The agriculture based Indian economy is facing a threat from increased human population, agro climatic and socio-economic constraints. This necessitates the identification of a livestock species, which is highly prolific and grows faster by converting food stuffs which are not commonly utilised by man to produce high quality animal protein to meet the deficient protein requirement.

With the continuing increase in human population, the per capita consumption of livestock products like meat and milk in India is still considerably lower than developed and other developing countries. The per capita availability of animal protein is about 9.6gm in India against the world average of 24.7gm and Indian Council of Medical Research recommended the average of 34gm (Shanmugasundram, 1997). In order to bridge the gap between demand and supply of animal proteins, there is an urgent need to increase the productivity of all meat animals. In this context, scope and potential of pig production appear to be tremendous than other meat animals, because of it's unique biological peculiarities.

Pigs are important meat producing livestock, and are versatile animals capable of withstanding diverse managemental and agro-climate conditions. High prolificacy, shorter generation interval, faster growth rate and utilisation of non-competitive feed offers pigs high potential for meat production. The above biological advantages of pigs play an important role to meet the animal protein deficiency at a very low cost. In the world, China stands first in the pig production sector.

Pigs belong to the Genus-*Sus Linn*, Order-*Artiodactyla*, Suborder-*Suiformis* and Family-*Suidae*. This classification includes the domesticated and several wild species such as common Indian Wild boar (*Sus Scrofa Cristatus*)

Domesticated pigs in India, are of three genetic groups.

I. Exotic pigs

II. Indigenous pigs

III. Crossbred pigs (Exotic X Indigenous)

1.1 Large White Yorkshire (LWY)

It is a native breed of United Kingdom. It is large in size with a long and slightly dished face. Skin is pink in colour and

free from wrinkles. These animals are good converters of feed. This breed has proved to be one of the most superior breed and is adopted well to confined condition. The mature boar weighs 295–408kg and the sow weighs 227 – 317kg.

Exotic pigs have been introduced into India during the past few decades from United Kingdom and other Western countries. Large White Yorkshire was introduced into Kerala Agricultural University during mid seventies to assess the suitability of the breed in the state. The result of the experiments reveals that climatic stress would be a limiting factor for the expression of genetic potential of the Large White Yorkshire. The litter size at birth and growth rate are much below when compared to those in temperate countries.

1.2 Indigenous pigs (Desi)

Gradual domestication of wild pigs led to the present population of Indigenous pigs. They differ in colour in different regions depending upon the topography and climatic conditions. The animals are black in colour with tapering face and thick hair. Head and shoulders are heavier than hindquarters with the tail

nearly reaching hock with a tuft of hair. Medium sized animal weighs about 40 – 70kg.

They are rich in genetic variability and are endowed with many positive aspects like disease resistance, tolerance to high heat and humidity. But, these animals are poor in reproductive traits like litter weight at birth and weaning, litter size at birth and weaning and economic traits like body weight gain, feed conversion efficiency and carcass traits.

1.3 Crossbred pigs (Large White Yorkshire X Desi)

Crossbreeding experiment involves mating of pure breds with Indigenous animals to produce 50 per cent exotic inheritance in the first filial (F_1) generation. Further mating of F_1 males with F_1 females is done to stabilize the exotic inheritance at the same level (50 per cent). By utilizing heterosis, the animal breeder has succeeded greatly in increasing production performance of Crossbred pigs compared to Indigenous pigs. In pigs, though sporadic attempts had been made to estimate the production performance through cross breeding, attempt for systematic studies are undertaken with the All India Co-ordinated

Project on Pigs during mid eighties to assess the production performance of crossbred pigs in India.

The litter size at birth and weaning, birth weight and pre-weaning mortality are basically fitness traits contributing to the multiplication and perpetuation of this species. Apart from these, growth rate of pig is considered as an important trait of economic importance because faster growing pigs require less labour, less feed per unit of gain compared to slower growing pigs. So, growth rate and feed conversion efficiency are the vital factors offering profitability to swine enterprise.

The economics of pork production depends upon the carcass traits such as dressing percentage, carcass length, back fat thickness and loin eye area. Efforts to increase dressing percentage and carcass weight are of utmost importance as they are related to the economic returns of swine production. Similarly, back fat thickness is a reliable indicator of total external fat. Loin eye area is an indirect measurement for assessing total lean meat. But all the above factors are related to breed, age and weight at the time of slaughter and have a direct effect on the quality and quantity of meat produced (Singh *et al.*, 1997a).

In view of the above factors, a comparative study on the performance of Exotic, Desi and their Crossbred pigs is too limited and is to be done for evaluating these breeds.

Thus, a research programme was undertaken with the following objective;

To evaluate and compare the litter traits in Large White Yorkshire, Desi and their Crossbred pigs and to decide upon a breeding strategy.

Review of Literature

2. REVIEW OF LITERATURE

The population of pigs in India generally consists of a very large proportion of native animals not conforming to any specific breed. The animals have good heat tolerance, mothering ability but poor feed conversion efficiency. The exotic pigs brought to our country are now adapted to the agro-climatic conditions. They have high body weight gain and feed conversion efficiency, but low mothering ability. The development of a crossbred pig combining qualities like heat tolerance and mothering ability from native pigs and high prolificacy and litter weight gain from exotic pigs would be best suited to the farming community.

2.1 Litter traits

The economy in swine production is influenced by litter traits such as litter size and weight at birth and at weaning and survivability. The number of piglets born per litter and the number that will be weaned out of them will determine the profitability of swine enterprise. But these traits have low heritability (10 per cent) and are expressed only by adult females.

So, these traits are not expected to respond to conventional selection techniques.

2.1.1 Large White Yorkshire

Gupta *et al.* (1983) concluded that the average litter weights of male and female piglets at birth was 5.84 ± 1.04 kg and 5.58 ± 1.05 kg and at weaning was 48.58 ± 2.84 kg and 46.29 ± 2.70 kg respectively. The sire was found to be a significant source of variation affecting litter weight at weaning.

According to Nambudiri and Thomas (1984) the mean litter size at birth, birth weight and pre-weaning weight gain during rainy season were 7.5 ± 0.16, 1.3 ± 0.01 kg and 7.75 ± 0.12 kg respectively and during dry season were 7.65 ± 0.18, 1.32 ± 0.01 kg and 7.39 ± 0.14 kg respectively.

Rai and Desai (1985) reported that the mean birth weight of male and female piglets were 1.232 ± 0.01 and 1.211 ± 0.01 kg and the mean weaning weight were 10.515 ± 0.17 and 10.074 ± 0.149 kg respectively. The sex had significant effect on weaning weight, but not on birth weight. The average litter size at birth excluding stillbirth was 8.08 and at weaning was 5.32.

The mean litter weight at birth was 9.896 ± 0.31kg and at weaning was 54.79 ± 3.01 kg.

Singh *et al.* (1986) showed that the litter size at birth was 8.90 ± 0.09 and at weaning was 6.62 ± 0.11.

The mean birth weight of male piglets was 1.085 ± 0.08 kg and the female piglets was 1.09 ± 0.07 kg and pooled mean birth weight was 1.09 ± 0.05 kg. The mean weaning weight of male piglets was 9.75 ± 1.06 kg and female piglets was 9.40 ± 0.79 kg (Dash and Mishra, 1986).

Chatterjee *et al.* (1987) reported that the litter size at birth and weaning, litter weight at birth and weaning and average birth weight and weaning weight were, 9.55 ± 0.55 and 7.77 ± 0.46, 10.61 ± 0.46 and 58.03 ± 3.91 kg, 1.11 ± 0.01 and 7.46 ± 0.302kg respectively.

According to Chatterjee *et al.* (1988), the litter size at weaning, litter weight at weaning was 6.89 ± 1.150, 45.19 ± 3.22 kg respectively. The litter weight at weaning and daily weight gain was directly and positively influenced by the litter size at

birth. Similarly, weaning weight and daily weight gain were influenced by the birth weight of the litter.

Chhabra *et al.* (1989) reported that the birth weight of male and female piglets were 1.24kg and 1.20kg. Sex of piglets had significant effect on birth and weaning weight. Litter size at birth had significant effect on all body weights.

Mishra *et al.* (1990a) reported that the litter size at birth and weaning were significantly higher at Jabalpur farm (9.8 ± 0.25 and 8.8 ± 0.22 respectively) as compared to Tirupati farm (7.6 ± 0.32 and 7.2 ± 0.35 respectively). The litter weight at birth and weaning were also significantly higher at Jabalpur farm (12.1 ± 0.26kg and 100.7 ± 2.17kg respectively) as compared to Tirupati farm (10.2 ± 0.46kg and 92.2 ± 4.50kg respectively).

Sharma *et al.* (1990) observed that the mean birth weight of male piglets was 1.23 ± 0.02 kg and female piglets were 1.17 ± 0.03kg. The weaning weight of male piglets was 9.77 ± 0.18kg and female piglets was 9.81 ± 0.26kg.

The litter size at birth and weaning were reported to be 8.81±0.39 and 6.78±0.33 respectively and the birth weight and

weaning weight were reported to be 1.3 ± 0.01kg and 7.77 ± 0.17kg respectively (Singh *et al.*, 1990a, b).

Mishra *et al.* (1990c) reported that the male piglets (1.29 ± 0.007kg) were of higher birth weight than female piglets (1.25 ± 0.008kg) and significant difference was observed between the sexes.

According to Chhabra *et al.* (1990) the litter size at birth and weaning and litter weight at birth and weaning were, 12.0 and 10.0, 14.9 kg and 186.3 kg respectively. The year or season of farrowing did not have significant effect on litter size at any of the stages.

Lakhani (1992) observed that the average weaning weight of male and females were 11.93 ± 0.11 kg and 11.38 ± 0.12 kg respectively. The overall weaning weight was 11.54 ± 0.08 kg. The litter size at birth was found to have significant effect on weaning weight in Large White Yorkshire

Jayarajan and Ulaganathan (1992) reported that the mean body weight was 1.26 ± 0.011 kg at birth and 10.79 ± 0.06

kg at weaning. Seasonal differences were found to have important role from birth to weaning.

Mathew (1992) studied that the litter size at birth and weaning, litter weight at birth and weaning, average birth and weaning weight were, 6.25 ± 0.48 and 5.00 ± 0.58, 9.30 ± 0.66kg and 51.53 ± 1.58kg, 1.50 ± 0.09kg and 10.64 ± 0.08kg respectively.

Samanta *et al.* (1996) noticed that the litter size and litter weight at birth and weaning were, 8.67 ± 0.55, 12.53 ± 0.65kg and 7.33 ± 0.63, 58.86 ± 4.42kg respectively, which did not vary significantly with season of farrowing.

According to Mathew (1997), the litter size at birth and weaning, litter weight at birth and weaning, average birth weight and weaning weight were, 7.47 ± 0.22 and 5.88 ± 0.44, 8.65 ± 0.29kg and 52.58 ± 4.39kg, 1.26 ± 0.03kg and 8.92 ± 0.06kg respectively.

Ramesh (1998) concluded that the litter size at birth and weaning, litter weight at birth and weaning, average birth and

weaning weight were 7.09 ± 0.18 and 4.63 ± 0.21, 10.73 ± 0.21kg and 38.46 ± 3.21kg, 1.47 ± 0.01kg and 8.42 ± 0.09kg respectively.

Singh *et al.* (1999) reported that the weaning weight at Jabalpur and Tirupati centres were 11.69 ± 0.30 kg and 11.76 ± 0.11 kg respectively at eight weeks of age.

2.1.2 Desi

Lakhani (1988) observed that the average litter weight at birth of male and female indigenous pigs at Jabalpur were, 2.23 ± 0.16 kg and 1.86 ± 0.16 kg and at weaning were 16.6 ± 1.68 kg and 15.73 ± 1.47 kg. The difference between sex was not significant and the sire was a significant source of variation affecting the litter weight at weaning.

Lakhani and Bhadoria (1988) reported that the average weaning weight of male and female piglets were 6.323 ± 0.168 kg and 6.42 ± 0.201 kg respectively in Jabalpur. The sex had no significant effect on weaning weight.

Mishra *et al.* (1989a) studied that the litter size at birth was the highest for local pigs at Izatnagar 7.57 ± 0.27

followed by Jabalpur (6.52 ± 0.16), Tirupati (6.22 ± 0.18) and Khanapara (4.93 ± 0.12) farms.

The birth weight was observed to be 0.85 ± 0.007kg, 0.76 ± 0.008kg, 0.73 ± 0.006kg and 0.70 ± 0.006kg at Khanapara, Izatnagar, Tirupati and Jabalpur centres respectively. The sex had no significant effect on birth weight at any center and the litter size had significant effect on birth weight at all centres (Mishra *et al.*, 1989b).

Mishra *et al.* (1990b) reported that the litter weight at weaning was maximum at Izatnagar (43.21 ± 1.83kg) followed by Tirupati (42.57 ± 1.48kg), Jabalpur (34.96 ± 1.24kg) and Khanapara (28.49 ± 0.91kg). Year and farm environment were found to have significant effect on litter weight at weaning.

According to Lakhani and Bhadoria (1990), the litter size at birth and weaning, litter weight at birth and weaning, average birth and weaning weight were, 6.62 ± 0.155 and 4.99 ± 0.22, 4.55 ± 0.11kg and 32.68 ± 1.45kg, 0.7 ± 0.005kg and 6.48 ± 0.072kg respectively at Jabalpur farm.

Sharma *et al.* (1990) concluded that the mean birth weight of male and female piglets were 0.63 ± 0.03kg and 0.64 ± 0.03kg respectively. Similarly, the mean weaning weight of male and female piglets were 5.38 ± 0.32kg and 5.23 ± 0.24kg respectively in Bihar. The average litter weight at birth was 2.86 ± 0.27kg and at weaning was 12.46 ± 1.52kg and the litter size at birth and weaning was reported to be 6.02 ± 0.25 and 4.22 ± 0.25 respectively (Singh *et al.*, 1990a, b).

Mukhopadhyay *et al.* (1991) observed that the litter size at birth had significant effect on body weight during pre-weaning period and that sex had no significant effect on both birth and weaning weights.

The average litter size at birth of indigenous pigs in Jabalpur was 6.62 ± 0.15 and average birth weight was 0.7 ± 0.005kg. But the litter size at weaning was 4.29 ± 0.221 with an average weaning weight of 6.48 ± 0.072kg (Lakhani and Bhadoria, 1991).

Shylla *et al.* (1991) observed that the birth weight and weaning weight of Doom pigs of Assam were 0.92 ± 0.01kg and

7.44 ± 0.10kg respectively. The effect of sex was found to have no significant effect on above traits except at birth weight.

Deo *et al.* (1992) observed that the birth weight and weaning weight were 0.56kg and 7.41kg respectively in local pigs of Izatnagar. The effect of sex on body weights at different stages was not found to be significant.

Jogi and Johar (1994) reported that the mean weaning weight of males was 7.68 ± 0.045kg and females were 7.51 ± 0.047kg. The sire had significant effect on weaning weight, but there was no significant difference between sexes on weaning weight.

Kumari *et al.* (1994) reported that the litter size at birth and weaning, litter weight at birth and weaning were 6.67 ± 0.13 and 5.31 ± 0.12, 4.84 ± 0.10kg and 43.92 ± 1.05kg respectively in Tirupati. The season of birth had significant influence on litter weight at birth and weaning.

The litter size at birth and weaning averaged 7.56 and 5.01 and the litter weight at birth and weaning averaged 4.57kg and 33.57kg in local pigs of Izatnagar (Chhabra *et al.*, 1996a),

while Gaur *et al.* (1996) reported that the birth weight and weaning weight was 0.68kg and 6.45kg respectively in Izatnagar. Litter size was found to have significant effect on body weight from birth to 20 weeks.

Studies conducted by Jogi and Johar (1996) revealed that the litter size at birth and weaning, litter weight at birth and weaning were 6.49 ± 0.71 and 6.017 ± 0.048, 5.02 ± 0.023kg and 43.89 ± 0.465kg respectively at Jabalpur. The effect of sire was found to be significant for litter size at birth.

The birth weight and weaning weight of Desi pigs at Bihar were 0.69 ± 0.02kg and 6.10 ± 0.24kg respectively. The litter size at birth and weaning, litter weight at birth and weaning were 6.32 ± 0.40 and 4.36 ± 0.43, 5.06 ± 0.56kg and 25.5 ± 3.12kg respectively in Bihar. The sex of piglets had no significant effect on body weight at different age groups (Singh and Devi, 1997a, b).

Mathew (1997) reported that the litter size at birth and weaning, litter weight at birth and weaning, average birth and weaning weight were 5.81 ± 0.30 and 4.51 ± 0.52, 3.73 ± 0.10kg and 32.12 ± 1.74kg, 0.75 ± 0.02kg and 7.21 ± 0.10kg respectively for Desi pigs reared at University Pig Breeding Farm, Mannuthy.

Goswami *et al.* (1999) reported that the mean litter size at birth and weaning were 5.53 ± 0.24 and 5.00 ± 0.25 respectively in Khanapara and Guwahati farm.

Bhargava *et al.* (1999) observed that the mean litter size at birth and weaning, litter weight at birth and weaning were 4.88 ± 0.68 and 3.33 ± 0.70, 4.55 ± 0.71kg and 42.66 ± 6.91kg respectively for local pigs in Tirupati.

2.1.3 Crossbred

Dash and Mishra (1986) reported that the average birth weight of male and female Crossbred piglets in Orissa were 1.03 ± 0.07kg and 1.01 ± 0.06kg respectively.

In West Bengal, the litter size at birth and weaning, litter weight at birth and weaning, average birth and weaning weight were, 8.22 ± 0.52 and 5.88 ± 0.51, 8.88 ± 0.41kg and 36.69 ± 3.88kg, 1.05 ± 0.03kg and 6.23 ± 0.33kg respectively in 75 per cent Crossbred pigs (Chatterjee *et al.*, 1987).

The litter size and litter weight at weaning were 6.68 ± 1.14 and 43.29 ± 3.21kg respectively in Large White

Yorkshire X Desi halfbred pigs of West Bengal as reported by Chatterjee *et al.* (1988).

In Bihar, Sharma *et al.* (1990) reported that the birth weight of male and female piglets were 1.00 ± 0.04kg and 1.06 ± 0.04kg respectively. The weaning weight of male and female piglets was 7.43 ± 0.12kg and 7.81 ± 0.19kg in Crossbred pigs. Sex of the piglet had no significant effect on birth weight and weaning weight on Large White Yorkshire, Desi and Crossbred pigs. But Singh *et al.* (1990a) reported the birth weight and weaning weight of Crossbred pigs was 0.91 ± 0.01kg and 7.23 ± 0.14kg respectively. The highest weight at all the ages from birth to 16th week of age was noticed in Large White Yorkshire followed by Crossbred and Desi pigs.

Sharma *et al.* (1992) observed a higher weaning weight of 8.05 ± 0.14kg in Crossbred pigs. Litter size at weaning had significant effect on weaning weight in Crossbred pigs.

Lakhani and Jogi (1998) reported that the birth weight was 0.77 ± 0.058kg in Crossbred pigs of Jabalpur. Sire effect was highly significant for birth weight in Large White Yorkshire, Desi and their Crossbred pigs. But Das and Gaur (1999) reported that

the litter size at birth and weaning, litter weight at birth and weaning were 5.60 ± 0.19 and 4.86 ± 0.19, 4.93 ± 0.18kg and 49.05 ± 1.93kg respectively in Izatnagar.

In Tirupati, the litter size at birth and weaning, litter weight at birth and weaning were 7.87 ± 0.77 and 6.12 ± 0.81, 8.73 ± 0.83kg and 76.24 ± 8.23kg respectively for Crossbred pigs at Tirupati (Bhargava *et al.*, 1999).

2.2 Pre-weaning mortality

Pre-weaning mortality is an important litter trait, contributing to economic loss in swine industry. The survivability of pigs mainly depends upon several factors viz., management practices, parity of dam, litter size at birth, season of birth, age and weight of dam at farrowing. The tangible and indirect economic loss incurred due to high pre-weaning mortality, especially in small scale piggeries is high. Higher survival rate of the pigs born is an important objective of all swine raisers.

2.2.1 Large White Yorkshire

The incidence of pre-weaning mortality is closely related to the age of the piglet and is influenced by a number of

factors as duration and season of farrowing, litter size, weight of the piglet at birth and weight loss of sow from parturition to weaning (Sadana and Singh, 1972).

Pillai and Thomas (1984) observed that the pre-weaning mortality was highest during the first three weeks and progressively reduced at weaning.

Studies by Singh *et al.* (1986) showed that the mortality percentage up to weaning was 25.71 ± 0.27 per cent. The mortality was highest during winter. But the mortality percentage of sixth and eighth week weaning groups were, 21.46 ± 3.26 per cent and 18.61 ± 2.06 per cent respectively as reported by Chatterjee *et al.* (1987).

Chakrabarti and Basak (1986) observed that the piglet mortality was 36.61 per cent up to weaning. Crushing was found to be responsible for high death rate amongst piglets during their first week of life.

The pre-weaning mortality of 21.02 ± 3.96 per cent as reported by Chatterjee *et al.* (1988) and 23.07 per cent as reported by Singh *et al.* (1990b). They also observed that the effect of sex

was not significant but the age effect significant on pre-weaning mortality.

Sriraman and Krishnamacharyulu (1991) noted that the overall loss among the piglet was 11.32 per cent from birth to weaning.

Parity and litter size at birth affected survival percentage significantly and decrease in survivability was observed with advancing parity. The overall survival per cent was 83.27 (Chhabra *et al.*, 1991).

Litter size at birth and birth weight had significant effect on mortality rate of the piglets (Panday *et al.*, 1995).

Mathew (1997) reported the pre-weaning mortality of Large White Yorkshire pigs at University Pig Breeding Farm of Mannuthy as 24.52 ± 0.27 per cent.

2.2.2 Desi

Prasad *et al.* (1987) reported that the pre-weaning mortality was 21.82 per cent in Izatnagar and no significant effect due to sex were observed on piglet mortality.

Lal *et al.* (1988b) studied that the mortality was highest at Khanapara (27.19 per cent) followed by Jabalpur (21.62 per cent) and Tirupati (20.02 per cent) while Kumar *et al.* (1990) reported a significantly higher mortality from birth to weaning in Desi pigs (35.71 per cent) at Bihar.

Sriraman and Krishnamacharyulu (1991) studied that the pre-weaning losses in Tirupati was 19.95 per cent and the losses were more in summer. Munyua *et al.* (1991) reported a pre-weaning mortality of 15.78 per cent in Central Kenya Desi pigs.

Jogi *et al.* (1993b) reported that the pre-weaning mortality was 38.05 per cent. The generation and sire differences were of no significance on pre-weaning mortality. The mortality was mostly of environmental effect rather than genetic effect at Jabalpur.

Mathew (1997) reported that the pre-weaning mortality was 24.05 ± 0.80 per cent for Desi pigs at Mannuthy.

2.2.3 Crossbred

The pre-weaning mortality of sixth and eighth week weaning groups were 23.49 ± 9.56 per cent and 27.41 ± 5.87 per cent respectively in 75 per cent Crossbred pigs at West Bengal (Chatterjee *et al.*, 1987).

Chatterjee *et al.* (1988) reported that the pre-weaning mortality was 22.19 ± 3.95 per cent in Crossbred pigs at West Bengal.

Pandey *et al.* (1995) concluded that the mortality of Crossbred pigs was 3.47 ± 0.50 per cent. Litter size at birth and birth weight had significant effect on mortality rate at Bihar.

2.3 Effect of genetic group on litter traits

Deo *et al.* (1979) reported that the genetic group had no significant influence on litter size at birth, litter weight at birth and weaning, but had significant influence on litter size at weaning in Large White Yorkshire, Desi and their Crossbred pigs.

Singh *et al.* (1990a, b) observed significant effect of genetic group on birth weight, weaning weight, litter size at birth and weaning, litter weight at birth and weaning and pre-weaning mortality in Large White Yorkshire, Desi and their Crossbred pigs.

Pandey *et al.* (1995) reported that the genetic group had significant effect on mortality rate in Large White Yorkshire, Hampshire and Desi and their Crossbred pigs at Bihar.

Singh *et al.* (1997b) observed that genetic group had high significant effect on birth weight, while Lakhani and Jogi (1998) observed no significant effect of genetic group on birth weight in Desi and Large White Yorkshire grades.

Bhargava *et al.* (1999) reported that the litter size at birth and weaning was significantly influenced by the effect of genetic group. The litter weight at birth and weaning was also significantly influenced by the effect of genetic group.

2.4 Growth

Growth, the measure in terms of body weight, is an important economic trait. It influences the overall economics of

swine production. The growth rate is moderate to high heritable than litter traits. So it mostly depends upon genetic factors rather than environmental. It indicates that the selection of the animals based on growth rate is highly useful. The studies on growth performance of Desi and Crossbred pigs are scanty compared to Large White Yorkshire.

2.4.1 Large White Yorkshire

Somayazulu and Agarwal (1985) concluded that the weight of pigs at slaughter could be predicted in advance using body weight up to 20th week of growth when a uniform system of management is practiced. Growth rate of pigs increased from four to sixth months of age and decreased thereafter.

Dash and Mishra (1986) reported that the body weight of male and female pigs at 24 weeks were 29.42 ± 0.86kg and 29.40 ± 0.82kg respectively. For weight gain at 24th week, there was significant difference between Large White Yorkshire and Crossbred male piglets.

Chatterjee *et al.* (1987) observed that the average daily gain in weight from birth to 24th week was 119.53 ± 3.17gm in eighth week weaning groups.

Chatterjee *et al.* (1988) revealed that the weight gain during weaning and daily weight gain varied significantly from breed to breed. In purebreds the weight gains were always higher than in crossbred. The litter size at weaning, weight gain during weaning and daily weight gain were directly and positively influenced by the litter size at birth.

Sharma *et al.* (1990) reported that the body weight at the end of 26th and 30th weeks were 25.55 ± 0.41kg and 33.72 ± 0.43kg respectively.

The fifth month body weight of male and female pigs was 61.60 ± 0.57kg and 58.94 ± 0.42kg respectively. The year difference was significant for the body weight at all ages (Jayarajan and Ulaganathan, 1992).

Leena (1992) reported that the body weight at weaning was 8.5 ± 0.669kg and at eight months of age was 67.0 ± 4.902kg. The average rate of growth increased from the birth to the fourth

month and thereafter showed a declining tendency. The absolute daily gain increased from 218gm in the first month to a peak of 600gm in the fourth month and then declined to 319gm from fifth months.

Pradhan (1993) found the average body weight increased from 9.00 ± 0.34kg at weaning to 74.98 ± 1.34kg at 32nd week of age. The daily gain in weight increased from 131.62 ± 1.738gm at 10th week to a peak of 392.28 ± 9.34gm at 32nd week, thereafter declining to 384.60 ± 6.98gm at 40th week of age.

The body weight of pigs had increased progressively from weaning (9.64 ± 0.82kg) to eighth month of age (83.48 ± 2.70kg). Pigs showed progressive increase in the average daily gain in weight from 137.84 ± 23.7 gm at weaning to 439.28 ± 10.05 gm at eight months of age (Kannan, 1995).

Pandey *et al.* (1996) reported that the genetic group difference in daily weight gain was significant from birth to 21st week of age. The interaction between genetic group and sex had no significant effect on post-weaning and the pre-weaning daily

weight gain in all the ages. Similarly, the post-weaning weight gain gradually increased with the increased weaning weight.

The body weight of pigs increased from weaning (12.6 ± 0.65kg) to fifth months (42.813 ± 3.752kg) of age, with the average daily gain of 237.70 ± 49.53gm (Mathew, 1997).

2.4.2 Desi

Lal *et al.* (1988a) studied that the weight at 32 weeks of age were 48.28kg, 32.32kg and 28.43kg at Tirupati, Jabalpur and Khanapara centres respectively. It was observed that the body weight followed linear and quadratic trend for pre and post-weaning growth rates respectively.

The average body weights of Desi pigs were 15.26 ± 0.91kg and 19.00 ± 1.20kg at 26^{th} week and 30^{th} week respectively at Ranchi (Sharma *et al.*, 1990).

Lakhani and Bhadoria (1991) reported that the weight at 24^{th} week and 32^{nd} week were 20.14 ± 0.292kg and 32.47 ± 0.339kg respectively at Jabalpur.

It was observed that the average body weight of the Doom pigs of Assam were at 24th, 28th and 32nd week of age as 19.15 ± 0.35kg, 23.48 ± 0.44kg and 28.70 ± 0.52kg respectively. The rate of growth was relatively faster from birth to weaning as well as from 20th to 32nd week. The sex of the animal did not affect the body weight (Shylla *et al.*, 1991).

Mukhopadhyay *et al.* (1991) reported that at 30th week the body weight was 10.57 ± 2.92 at Ranchi. Season of birth had significant effect on body weight at all the ages except at 22nd week.

Deo *et al.* (1992) reported that the weight at 32 weeks of age was 39.89kg at Izatnagar. Piglets born in small litters weighed significantly heavier at all ages than those with larger litter. The effect of sex of animal on body weight at different ages was not significant.

The least squares means for daily gain in pre-weaning and post-weaning periods were estimated to be 107gm and 184gm respectively. The average daily gain from 24 to 28 weeks and 28 to 32 weeks were 265 ± 10gm and 272 ± 8gm respectively in

Izatnagar. The effect of dam and sex was found to be significant for average daily gain (Chauhan *et al.*, 1993).

Chhabra *et al.* (1996b) reported that the body weights at 24th and 28th, 32 weeks were 23.88kg and 31.20kg, 38.53kg respectively at Izatnagar. The effect of litter size was significant on body weight at all the ages. The sex had no significant effect on piglet weight upto 16th week of age.

Gaur *et al.* (1996) observed that the Desi piglets had significantly lower weight at all the ages as compared to Large White Yorkshire, Desi and Crossbred pigs.

The body weights at three, six and eight months of age were 9.86 ± 0.16kg, 22.00 ± 0.19kg and 34.79 ± 1.02kg respectively at Jabalpur. The effect of sire was highly significant for all post-weaning body weights and sex had significant influence on growth (Jogi and Johar, 1997).

Gaur *et al.* (1997) studied that the body weight at 32 weeks of age was 36.42kg in Izatnagar. The effect of sire was significant for all stages of growth. The litter size and sex significantly affected the growth rate in most of the periods.

The body weights of indigenous pigs at the end of 32 weeks were 40.43 ± 2.70kg (Izatnagar), 31.78 ± 1.39kg (Jabalpur) and 42.91 ± 1.04kg (Tirupati), 38.05 ± 1.44kg (Khanapara) and 31.32 ± 0.45kg (Mannuthy), 33.01 ± 1.48kg (Kattupakkam) - (AICRP Report, 1997).

2.4.3 Crossbred

Dash and Mishra (1986) reported that the body weights of male and female pigs at the end of 24th week were 26.17 ± 1.73kg and 27.21 ± 1.37kg. For live weight gain, the difference was significant between Large White Yorkshire and Crossbred male piglets at 24th week in Orissa.

The average daily gain in weight from birth to 24th weeks was 115.24 ± 2.8gm in eighth week weaning groups of 75 per cent Crossbred pigs at West Bengal (Chatterjee *et al.*, 1987).

In Ranchi, the body weights of Crossbred pigs at 26th and 30th weeks were 24.08 ± 0.52kg and 30.26 ± 0.49kg. The body weight of halfbreds was almost equal to that of Large White Yorkshire, but much higher than that of Desi at all the ages (Sharma *et al.*, 1990).

Pandey *et al.* (1996) observed that the post weaning daily gain was 138.06 ± 3.46gm in Crossbred pigs of Jabalpur. The effect of birth weight on post-weaning daily weight gain was not significant while weaning weight had significant influence on post-weaning daily gain.

The body weights of Large White Yorkshire half bred pigs at the end of eight months of age were 49.01 ± 1.99kg and 57.74 ± 4.4kg, 46.37 ± 0.93kg at Jabalpur, Tirupati and Izatnagar centres respectively (AICRP Report, 1997).

Suraj (2000) observed the mean average daily gain in weight of Large White Yorkshire, Crossbred and Desi pigs were 420 ± 0.63gm, 330 ± 0.46 and 234 ± 0.36gm respectively and the body weight of Large White Yorkshire and Crossbred pigs were same from weaning to third month of age after that it will vary upto slaughter age. The maximum ADG was noticed during fifth month of age in all three genetic groups.

2.5 Effect of genetic group on growth

A significant effect of genetic group on body weight was observed at various ages, while the effect of sex was not significant on any of the growth traits (Kumar *et al.*, 1990).

Mukhopadhyay *et al.* (1991) reported significant effect of genetic group on body weight at all ages. The interaction between genetic group and sex had no significant effect on body weight upto 12 weeks of age, thereafter it was significant.

Genetic group differences were observed to be highly significant at all stages of body weight in the studies conducted by Deo *et al.* (1992) and Gaur *et al.* (1996) and Singh *et al.* (1996) reported a high significant effect of genetic group on body weight at all the ages at monthly intervals from weaning to six months of age.

Singh *et al.* (1997b) observed that the genetic group had higher significant on body weight from birth to slaughter age.

Suraj (2000) noted that there was no significant difference for Large White Yorkshire and Crossbred pigs at third month of age after, which it showed significant difference upto slaughter age but keeping significant difference for Desi in all ages.

2.6 Feed conversion efficiency (FCE)

Major expenses involved in commercial piggery units are feed costs, which account for 70 to 80 per cent of the total cost of production. Nearly all of the variations in production costs among pigs within a herd are due to difference in the efficiency of feed utilisation.

2.6.1 Large White Yorkshire

Dash and Mishra (1986) reported that the FCE for Large White Yorkshire was 4.40 at 20 weeks, while the same at 24 weeks was 5.39. The feed conversion efficiency decreased with increase in the slaughter age, and it was higher in Large White Yorkshire piglets than in Crossbred piglets.

Singh *et al.* (1990a) studied that the Large White Yorkshire piglets showed significantly higher feed conversion efficiency of 4.45 from weaning to four months of age. The efficiency of feed utilisation increased with the increase of age.

Pradhan (1993) found that in pigs daily feed intake increased from 0.807 ± 0.016 to 1.985 ± 0.056 kg from tenth week

to 40th week of age. The feed conversion efficiency of 6.92 ± 0.97 was noticed at 10th week and 5.19 ± 0.09 at 40th week of age. The maximum feed conversion efficiency of 3.62 ± 0.10 was noticed at 24th week of age.

Singh *et al.* (1994) reported that the average feed conversion efficiency in Large White Yorkshire was 4.452 ± 0.081 from weaning to 24th week of age. He also observed that significantly superior feed conversion efficiency ratio in females than in males.

The average feed conversion efficiency was 6.92 ± 0.92 at three month of age and the efficiency was improved thereafter till eight months of age (4.19 ± 0.13). The higher FCE of 3.62 ± 0.11 was noticed on fourth month (Kannan, 1995).

Mathew (1997) reported that the average daily feed intake of Large White Yorkshire pigs at University Pig Breeding Farm, Mannuthy was 1.319 kg up to fifth month of age with feed conversion efficiency of 5.542.

2.6.2 Desi

An average feed conversion efficiency of 5.12 and 3.83 was observed in the indigenous male and indigenous female respectively from weaning to seven months of age at Mannuthy (Saseendran, 1979).

Singh *et al.* (1990a) reported that the Desi piglets showed significantly lowest feed conversion efficiency of 5.76. The efficiency of feed utilisation ratio increased with the increase of age at Ranchi from weaning to four month of age.

The Desi piglets showed significantly lower feed conversion efficiency of 5.76 in Ranchi. The significant effect of age on efficiency of feed utilisation was observed from weaning to four month of age (Kumar *et al.*, 1990).

Lakhani and Bhadoria (1991) studied that the average feed conversion efficiency from weaning to 24 weeks was 4.63 and that of 32 weeks was 4.82 at Jabalpur.

The average feed conversion efficiency in Desi (5.34 ± 0.174) from weaning to 26th week of age. Significantly

better feed conversion was observed in Desi females (4.798) than in Desi males (5.892) at Ranchi as reported by Singh *et al.* (1994).

Mathew (1997) noted an average daily feed intake of 1.100 kg up to fifth months of age with feed efficiency of 7.971 at Mannuthy.

2.6.3 Crossbred

Dash and Mishra (1986) noted that the average feed conversion efficiency for Crossbred pigs were 4.50 and 5.94 at 20 and 24 weeks respectively. The feed conversion efficiency decreased with increase in slaughter age.

Singh *et al.* (1990a) reported that Crossbred piglets showed significantly low feed efficiency of 4.62 from weaning to four months of age at Ranchi.

The average feed conversion efficiency in Large White Yorkshire, Crossbred and Desi pigs were 3.821 ± 0.212, 4.001 ± 0.404 and 6.412 ± 0.717 respectively at eight month of age (Suraj, 2000).

2.7 Carcass characteristics

Feed conversion efficiency and carcass quality are vital factors influencing the cost of fattener pig production in swine industry. The carcass return is quite high ranging from 65 to 80 per cent of the live weight (Samanta *et al.*, 1995). It is believed that the castrated male pigs grow faster and their meat being free from boar taint, is more delicious and palatable. The aim of swine husbandry is to produce quality pork. So, all efforts are directed to achieve a maximum dressing percentage at slaughter, low back fat thickness and leaner meat. These factors are related to breed, live weight, age, nutritional status, environment and miscellaneous factors.

2.7.1 Large White Yorkshire

Ramaswami *et al.* (1985) in the experiment to assess the slaughter weight reported that the back fat thickness and dressing percentage were 3.27 ± 0.05cm and 79.32 ± 0.38 per cent respectively.

Mishra and Sharma (1991) reported that the back fat thickness, loin eye area and dressing percentage were, 2.82 ± 0.09cm and 24.31 ± 0.76cm^2, 79.72 ± 0.50 per cent respectively. Increase in carcass weight showed a corresponding increase in average back fat thickness and carcass length.

Dressing percentage with head, carcass length, eye muscle area and back fat thickness were 75.8 per cent, 71cm and 31.6cm^2, 2.41cm respectively (Leena, 1992).

In the investigation carried out by Sasidaran (1997) the back fat thickness, loin eye area and dressing percentage were 24.60 ± 1.40 mm, 27.06 ± 1.40 cm^2 and 73.2 per cent respectively.

The back fat thickness, loin eye area and dressing percentage were 2.47 ± 0.20cm, 40.41 ± 2.97cm^2 and 66.76 per cent respectively of halothane sensitive Large White Yorkshire pigs at Mannuthy (Mathew, 1997).

Sarma and Reddy (1997) concluded that pigs of lesser weight gave more lean cuts than the pigs of heavier pigs and had a dressing percentage of 71.44 per cent.

The carcass weight, carcass length and back fat thickness were 83.35 ± 0.88kg, 87.32 ± 0.40cm and 30.45 ± 0.57mm respectively (Singh *et al.*, 1997a).

An investigation carried out by Singh *et al.* (1998) revealed that there was significant effect of age on all carcass traits. The traits measured were carcass length (72.12 ± 0.37cm) and back fat thickness (24.98 ± 0.44mm), loin eye area (22.29 ± 0.46cm^2) and dressing percentage (75.81 ± 0.47 per cent).

Hicks *et al.* (1998) reported that in Large White Yorkshire barrows the loin eye area, back fat thickness and dressing percentage were, 19.5cm^2, 25.9mm and 69.1 per cent respectively.

2.7.2 Desi

Saseendran (1979) observed that the back fat thickness and loin eye area were 1.27 cm and 7.5cm^2 respectively in Desi pigs at Mannuthy.

Singh and Singh (1985) reported that the carcass weight and dressing percentage were 22.05 ± 3.47kg and 55.31 per cent respectively for Desi pigs at Bihar.

Jogi *et al.* (1993a) reported that the mean dressing percentage ranged from 58.91 to 59.45 per cent and the carcass length was 56.12 ± 0.66cm with a back fat thickness of 2.82 ± 0.09cm. The effect of sires was observed to be significant on the above carcass traits.

Singh *et al.* (1997a) estimated that the carcass traits of Desi pigs of Ranchi and reported that the carcass length, back fat thickness and loin eye area were, 68.61 ± 0.84cm, 30.93 ± 1.20mm and 25.58 ± 1.36cm^2 respectively.

According to AICRP Report (1997), the carcass characteristics were reported as follows;

Table 1. Carcass characteristics of indigenous pigs at different centers

Traits	Jabalpur	Tirupati	Izatnagar	Khanapara
CL (cm)	58.8	54.68	59.7	51.53
BFT (cm)	2.33	2.35	2.74	2.11
LEA (cm^2)	16.99	19.16	19.81	16.13
DP (per cent)	65.13	77.50	69.77	69.60

Back fat thickness, loin eye area and dressing percentage were 1.62 ± 0.72cm, 15.68 ± 0.41cm^2 and 58.82 per cent respectively in Desi pigs of Kerala (Mathew, 1997).

2.7.3 Crossbred

A study carried out by Dash and Mishra (1986) in Crossbred pigs of Orissa revealed that the carcass length and back fat thickness were 42.25 ± 0.25cm and 0.90 ± 0.15cm respectively.

Bhattacharyya and Sundaram (1988) reported that the carcass length and dressing percentage of Crossbred males were 63 ± 0.87cm and 64.5 per cent respectively.

The carcass traits of Crossbred pigs of Ranchi were reported as carcass length (83.04 ± 0.63cm) and back fat thickness (30.21 ± 0.89mm) (Singh et al., 1997a).

Dressing percentage of Crossbred pigs at Mannuthy was 69.11±3.74 per cent (AICRP Report, 1999).

Suraj (2000) noticed that the dressing percentage of Large White Yorkshire was lower than that of Crossbred pigs and

Desi pigs. Carcass length, weight of gut and weight of internal organs of the crossbred pigs were intermediary between that of Large White Yorkshire and Desi pigs.

2.8 Effect of genetic group on carcass characteristics

The effect of genetic group, age group and sex on dressing percentage was not significant in Crossbred pigs of West Bengal (Samanta *et al.*, 1995).

But, Singh *et al.* (1997a) reported that the genetic group had significant effect on weight at slaughter, carcass length, back fat thickness and loin eye area. Sex and it's interaction with genetic group had no significant effect on weight at slaughter, carcass length, carcass weight, back fat thickness and loin eye area of Large White Yorkshire, Desi and their Crossbred pigs of Bihar.

The significant effect of genetic group on back fat thickness, loin eye area was noticed by Suraj (2000) in Large White Yorkshire, Crossbred and Desi pigs

2.9 Cost of production per kg live body weight

Cost of production per kg live body weight was lowest for Large White Yorkshire followed by Crossbreds and Desi pigs from weaning to eight month of age as reported by Mathew (1997) and Suraj (2000).

Materials and Methods

3. MATERIALS AND METHODS

The experimental work was carried out at Centre for Pig Production and Research (CPPR), Kerala Agricultural University, Mannuthy.

The experimental animals belonged to three genetic groups viz., Large White Yorkshire, Desi and their Crossbred pigs.

3.1 Technical programme

3.1.1 Litter traits

Three groups of 20-25 female pigs each belonging to Large White Yorkshire, Desi and their Crossbred pigs were bred with appropriate number of males of their respective genetic group. The progenies produced in each genetic group were compared for litter traits.

3.1.2 Growth and carcass study

A random sample of eight animals from each genetic group were selected at weaning and castrated. They were fed concentrate ration (composition as given in Appendix – I) from

weaning to eight months of age to study the growth, feed conversion efficiency and carcass characteristics. Concentrate feed was provided in the form of wet mash twice daily i.e., in the morning and evening.

All the experimental animals and their progenies were maintained under uniform housing, feeding and managemental practices prevailing in All India Co-ordinated Research Project (AICRP) on pigs at Centre for Pig Production and Research, Mannuthy.

3.2 Observations

The following data were collected on traits,

i) Birth weight.

ii) Litter size at birth.

iii) Litter weight at birth.

iv) Weaning weight at eight weeks of age.

v) Litter size at weaning.

vi) Litter weight at weaning.

vii) Pre-weaning mortality.

viii) Fortnightly body weight upto eight months of age.

ix) Average feed intake.

x) Carcass characteristics.

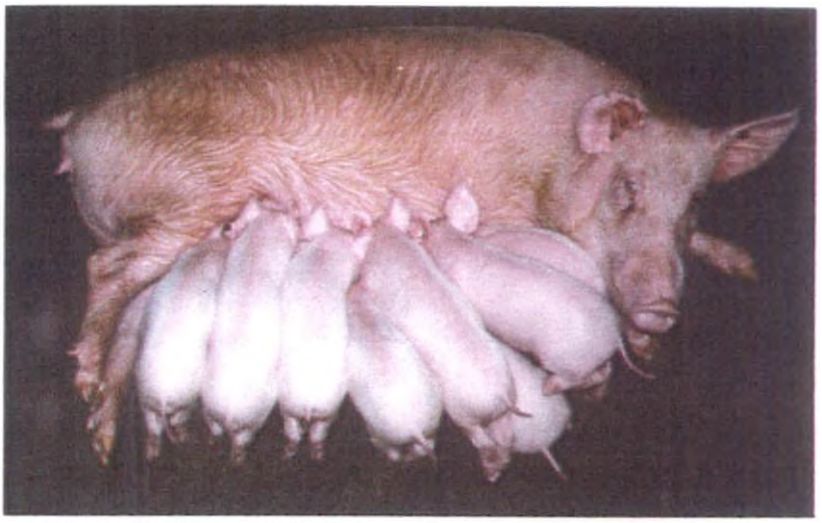

Plate 1. Sow with litter - Large White Yorkshire

Plate 2. Sow with litter - Desi

Plate 3. Sow with litter - Crossbred

The carcass traits measured were

1. Dressing percentage
2. Carcass length
3. Back fat thickness
4. Loin eye area
5. Carcass weight
6. Weight of gut and internal organs.

3.3 Statistical analysis

The mean, standard error and co-efficient of variation were estimated for all the traits studied in each genetic group (Snedecor and Cochran, 1981).

Least squares analysis of variance was performed to study effect of different factors on birth weight and weaning weight within each genetic group. The standard programme LSML (Harvey, 1986) was used for least squares analysis.

3.4 Birth weight

Three different factors were considered for analysing their effect on birth weight of piglets within a breed namely sex,

sire and litter size at birth and the data were classified accordingly.

3.4.1 Sex

The sex of the piglet in Large White Yorkshire, Desi and their Crossbred pigs was classified as

Male – 1 Female – 2

3.4.2 Sire

The number of sires in each genetic group was as follow;

Large White Yorkshire	=	1 to 12
Desi	=	1 to 7
Crossbred	=	1 to 7

3.4.3 Litter size at birth

Litter size at birth in all the three genetic groups was grouped as

Size 1	-	< 7
Size 2	-	8-9
Size 3	-	> 10

The statistical model used was

$$Y_{ijkl} = \mu + S_i + R_j + L_k + e_{ijkl}$$

Where,

Y_{ijkl} = The birth weight of the l^{th} piglet born in i^{th} sex of j^{th} sire and k^{th} litter size at birth.

μ = Overall mean

S_i = Effect of i^{th} sex (i=1-2)

R_j = Effect of j^{th} sire of genetic group

L_k = Effect of k^{th} litter size at birth (k = 1-3)

e_{ijkl} = Random error.

3.5 Weaning weight

The effect of sex, birth weight, sire, litter size at birth and litter size at weaning of piglets on weaning weight within a breed was analysed and the data were classified accordingly.

3.5.1 Sex, Sire and litter size at birth

The data were classified as earlier for analysing birth weight in three genetic groups.

3.5.2 Birth weight

Depending upon the genetic groups, birth weight was classified as follows:

	Large White Yorkshire	Desi	Crossbred
Group I	<1.0	<0.5	<0.75
Group II	1.01-1.25	0.51-0.70	0.76-1.0
Group III	1.26-1.50	0.71-1.0	1.01-1.25
Group IV	>1.51	>1	>1.26

3.5.3 Litter size at weaning

For Large White Yorkshire, Desi and their Crossbred pigs the litter size at weaning was classified as

	Large White Yorkshire	Desi	CB
Size I	<5	<5	<5
Size II	6-7	6-7	6-8
Size III	8-9	8-9	9-11

The statistical model used was

$$Y_{ijklmn} = \mu + S_i + R_j + L_k + B_l + W_m + e_{ijklmn}$$

Where,

Y_{ijklmn} = The weaning weight of the n^{th} pig born in i^{th} sex of j^{th} sire, k^{th} litter size at birth, l^{th} birth weight and m^{th} litter size at weaning.

μ = Overall mean

S_i = Effect of i^{th} sex (i=1-2)

R_j = Effect of j^{th} sire of genetic group

L_k = Effect of k^{th} litter size at birth (k = 1-3)

B_l = Effect of l^{th} birth weight (l=1-4)

W_m = Effect of m^{th} litter size at weaning (m = 1-3)

e_{ijklmn} = Random error.

3.6 Effect of genetic group on litter, growth and carcass traits

The method of analysis of variance was worked out as per the method of Snedecor and Cochran (1981).

The statistical model used was

$$Y_{ij} = \mu + Gi + e_{ij}$$

Where,

Y_{ij} = Observation of j^{th} trait of i^{th} genetic group

μ = Overall mean

G_i = *Effect of* i^{th} *genetic group assumed to be random* units with mean zero and variance σ^2_e

e_{ij} = Random error.

ANOVA table

Source	D.F	S.S	M.S.S	F
Genetic groups	S – 1	SSg	MSg	$\frac{MSg}{Mse}$
Error	N – S	SSe	MSe	

3.7 Fortnightly body weight

Body weight of each animal was recorded at fortnightly intervals and the average fortnightly body weight in three genetic groups were estimated from weaning to eight months of age and monthly average daily gain in weight also calculated.

3.8 Feed intake

Weighed quantity of concentrate ration was fed to each genetic group. The left over feed if any was weighed to calculate the monthly feed intake and monthly feed conversion efficiency also calculated for each genetic group.

3.9 Feed conversion efficiency (FCE)

Feed efficiency was calculated as a ratio of weight in gram of feed consumed to the weight gain in gram for each genetic group.

$$FCE = \frac{\text{Quantity of feed consumed}}{\text{Weight gain}}$$

3.10 Carcass study

Experimental animals were slaughtered at eight months of age and carcass study was carried out in Large White Yorkshire, Desi and Crossbred pigs and the following carcass traits were studied

3.10.1 Carcass length (CL)

The length of the carcass was measured from the anterior edge of the aitchbone to the anterior border of the first rib.

3.10.2 Back fat thickness (BFT)

It was estimated as an average of the measurements taken opposite to the first rib, the last rib and last lumbar vertebrae.

3.10.3 Loin eye area (LEA)

The area of the Longissimus dorsi muscle between 10^{th} and 11^{th} rib was cut and traced on a transparent paper and the area was measured by plotting the trace surface on graph paper.

3.10.4 Dressing percentage (DP)

The dressing percentage was calculated using the following formula,

$$DP = \frac{\text{Carcass weight}}{\text{Live body weight}} \times 100$$

3.11 Economics for calculating the cost of production per kg of live body weight in three genetic groups

Cost of production was calculated based on the assumptions (Mathew, 1997).

1) Feed constitutes 75 per cent of total cost of production in pigs.
2) Cost of weaned piglet and cost of maintenance of boar is identical for all genetic groups and hence not included in the cost of production.

The quantity of feed taken by three genetic groups in experimental period and its cost, total weight gain, feed conversion ratio were considered from weaning to eight months of age.

Results

4. RESULT

4.1 Litter traits

The average values for litter traits such as birth weight, litter size at birth and litter weight at birth, weaning weight, litter size at weaning and litter weight at weaning for Large White Yorkshire, Desi and Crossbred pigs are shown in Tables 2-4 respectively. For all litter traits Large White Yorkshire performed best followed by Crossbred and Desi pigs except for litter size at birth (Figures- 1 to 6)

4.2 Birth weight

Least squares mean for birth weight at different factors such as sex, sire, litter size at birth are detailed in Tables 5-7 for three genetic groups. The least squares analysis of variance for three genetic groups are presented in Table 8.

4.2.1 Effect of sex

In Large White Yorkshire and Desi pigs sex had no significant effect on birth weight. But in Crossbred pigs

significant effect of sex was noticed with an average of 1.054 ± 0.02kg and 0.982 ± 0.01kg for male and female piglets respectively.

4.2.2 Effect of sire

Sire had a significant ($P \leq 0.05$) effect on birth weight in all the three genetic groups.

In Large White Yorkshire, the sire number 11 had offsprings with highest average birth weight of 1.560 ± 0.059 kg and the piglets of sire number 12 were with lowest birth weight of 1.184±0.050 kg.

Sire number one in Crossbred pigs was with lower birth weight of 0.912 ± 0.027kg. But the offsprings of sire number seven were the heaviest with an average birth weight of 1.154±0.047kg.

The piglet of sire number two was having highest average birth weight of 0.687 ± 0.018kg and the lowest average birth weight of 0.494 ± 0.0259kg was recorded for sire number one in Desi pigs.

4.2.3 Effect of litter size at birth

Litter size at birth had significant effect on birth weight of piglets in all three genetic groups ($P \leq 0.05$).

The average least squares means of birth weight observed in litter size groups two, one and three were 1.409 ± 0.024kg, 1.397 ± 0.0276kg and 1.298 ± 0.0207kg respectively in Large White Yorkshire.

The highest least squares mean of birth weight was observed in litter size three group (0.664 ± 0.012kg) followed by litter size two group (0.638 ± 0.014kg) and the least value was recorded in litter size one group (0.488 ± 0.033) in Desi pigs.

In crossbred piglets the highest least squares mean of birth weight was observed in litter size two group (1.09 ± 0.018kg) followed by litter size one group (1.029±0.031kg) and litter size three group had the lowest mean of 0.935±0.02kg.

4.3 Weaning weight

Least squares mean for weaning weight according to sex, sire, litter size at birth and weaning and birth weight are

summarized in Tables 9-11 for three genetic groups and least squares analysis of variance of weaning weight for the three genetic groups is given in Table 12.

4.3.1 Effect of sex

Sex of the piglet had no significant effect on weaning weight in all the three genetic groups.

4.3.2 Effect of sire

Effect of sire was significant ($P \leq 0.05$) for weaning weight in three genetic groups.

The least squares mean for weaning weight was highest in sire number six with an average of 10.615 ± 0.385kg and lowest in sire number four with an average of 7.706 ± 0.513kg in Large White Yorkshire.

The least squares mean for sire number four and seven with an average weaning weight of highest 6.565 ± 0.270kg and lowest 4.935 ± 0.359kg respectively was observed in Desi pigs.

In crossbred pigs, the sire number two was with an average of 9.253 ± 0.362kg highest weight and the sire number one with an average of lowest weight 7.399 ± 0.317kg were recorded.

4.3.3 Effect of litter size at birth

Litter size at birth had significant ($P \leq 0.05$) effect on weaning weight in all the three genetic groups.

Highest average weaning weight was observed in litter size three groups (9.651 ± 0.246kg) followed by litter size one group (9.326 ± 0.300) and litter size two group had the lowest mean of 8.70 ± 0.276kg in Large White Yorkshire.

In Desi pigs, the litter size one group had higher weaning weight (6.230 ± 0.369) compared to 5.716 ± 0.218 and 5.045 ± 0.205kg for litter size two and three groups respectively.

In crossbred pigs litter size one group had highest least squares mean (8.568 ± 0.285kg) followed by litter size two group (8.382 ± 0.189) and litter size three group had least mean value of 8.009 ± 0.218kg.

4.3.4 Effect of litter size at weaning

Significant effect of litter size at weaning ($P < 0.05$) was noticed on weaning weight in Large White Yorkshire and Crossbred pigs. But in Desi pigs, there was no significant effect on weaning weight.

In Large White Yorkshire the average weaning weight for the litter size groups one, three and two were 9.616 ± 0.348kg, 9.373 ± 0.272kg and 8.687 ± 0.213 kg respectively.

In Desi pigs, the average weaning weight for the litter size groups three, one and two were 5.852 ± 0.217kg, 5.746 ± 0.227 and 5.393 ± 0.250kg respectively.

Highest least squares mean for average weaning weight in Crossbred pigs was observed in litter size one group with 9.222 ± 0.255kg followed by litter size two group with 8.590 ± 0.178kg and litter size three group had the lowest mean value of 7.147 ± 0.261kg.

4.3.5 Effect of birth weight

Effect of average birth weight on average weaning weight was significant in Large White Yorkshire and Crossbred pigs but not in Desi pigs.

The average weaning weight observed in birth weight group four was highest (9.863 ± 0.213kg) and birth weight group one was lowest (8.425 ± 0.46kg) in Large White Yorkshire.

Highest least squares mean for average weaning weight in Desi pigs was observed in birth weight three group with 6.019 ± 0.197kg followed by birth weight two group with 5.692 ± 0.169kg and birth weight one group had the lowest mean value of 5.280 ± 0.466kg.

In Crossbred pigs, the least squares means of average weaning weight for birth weight group four was highest of 9.064 ± 0.305kg. Lowest average weaning weight observed was 7.098 ± 0.392kg for birth weight group one.

4.4 Pre-weaning mortality

Table 13 indicates the pre-weaning mortality of Large White Yorkshire, Desi and Crossbred pigs.

The pre-weaning mortality of Large White Yorkshire, Desi and Crossbred pigs was 26.63 ± 0.180,37.952 ± 0.397 and 23.598 ± 0.301 percentage respectively. The genetic group had highly significant effect on pre-weaning mortality (Table 20).

4.5 Effect of genetic group on litter traits

The effect of genetic group is found to be highly significant ($P \leq 0.01$) for average birth weight (Table 14).

The weaning weight of Large White Yorkshire, Desi and Crossbred pigs showed high significant effect of genetic group (Table 15).

The genetic group had no significant effect on litter size at birth and weaning (Table 16-17). But they were found to be highly ($P \leq 0.01$) significant for litter weight at birth and weaning (Table 18-19).

4.6 Fortnightly body weight

The body weight of experimental animals was recorded from weaning to eight months of age at fortnightly intervals for three genetic groups and are presented in Table 21.

As age advances, the body weight of animals also increased with an average weight of 12^{th} fortnight measured at 76.50 ± 3.950 kg, 36.875 ± 1.757 and 66.625 ± 4.013 in Large White Yorkshire, Desi and Crossbred pigs respectively. From weaning to fourth fortnight of age, Large White Yorkshire and Crossbred pigs had similar growth pattern and showed variation in growth thereafter (Figure – 7).

Average daily weight gain is presented in Table 22 for three genetic groups. The highest ADG was noticed at fifth month for Large White Yorkshire (0.669 ± 0.025 g), Desi (0.216 ± 0.017) and 0.541 ± 0.027g (Crossbred pigs) respectively. A decreasing trend of ADG is noted upto seventh month of age then an increase during eighth month of age in all three genetic groups (Figure – 8).

4.7 Effect of genetic group on body weight

The genetic group was found to be highly significant ($P \leq 0.01$) for third, fifth and eighth months body weight in Large White Yorkshire, Desi, Crossbred pigs (Table 23-25). But, in third month there was no significant difference between Large White Yorkshire and Crossbred pigs (Table 26).

4.8 Feed conversion efficiency

The total feed intake of eight animals per genetic group were recorded and presented in the Table 27.

Average feed efficiency for three genetic groups are presented in Table 28. In Large White Yorkshire and Crossbred pigs the higher feed conversion efficiency of 2.773 ± 0.104 and 3.375 ± 0.256 for fifth month respectively was observed. But in Desi pigs, fourth month (3.265 ± 0.424) showed higher feed conversion efficiency.

4.9 Carcass characteristics

The mean and standard error of different carcass traits of three genetic groups are detailed in Table 29.

In Large White Yorkshire, Back fat thickness of 3.56 ± 0.19cm, Loin eye area of 20.8 ± 0.75 cm^2, Dressing percentage of 76.2 ± 0.69 per cent and carcass length of 65.0 ± 0.57cm were noticed.

The back fat thickness, loin eye area, dressing percentage and carcass length were 2.44 ± 0.13 cm, 12.9 ± 0.59 cm^2, 60.2 ± 0.72 per cent and 44.0 ± 0.42 cm respectively for Desi pigs.

But in crossbred pigs, the back fat thickness, dressing percentage, loin eye area and carcass length were 3.2 ± 0.31 cm, 71.15 ± 0.69 per cent, 17.9 ± 0.57 cm^2 and 58.0 ± 0.6 respectively.

For all these traits Large White Yorkshire performed better when compared to Crossbred and Desi pigs (Figure – 9).

4.10 Effect of genetic group on carcass traits

The genetic group was found to be highly significant for the dressing percentage, back fat thickness, loin eye area, carcass length and given in Table 30 to 33.

4.11 Cost of production per kg of live body weight

Cost of production per kg of live body weight in three genetic groups was calculated and presented in Table 34.

The cost of production per kg of live body weight in Large White Yorkshire, Desi and Crossbred pigs from weaning to eight months of age was estimated and was found to beRs. 47.04, Rs. 56.89 and 49.15 respectively.

Table 2. Mean, standard error and Co-efficient of Variation for litter traits in Large White Yorkshire pigs

Litter traits	Large white Yorkshire	
	Mean ± SE	CV (percentage)
Birth weight (kg)	1.368 ± 0.013 (345)	18.1
Litter size at birth	8.652 ± 0.269 (40)	19.7
Litter weight at birth (kg)	11.848 ± 0.34 (40)	18.2
Weaning weight (kg)	9.226 ± 0.167 (262)	21.8
Litter size at weaning	6.575 ± 0.257 (40)	24.1
Litter weight at weaning (kg)	62.457 ± 2.52 (40)	25.5

(Values in parenthesis indicate number of observations)

Table 3. Mean, standard error and Co-efficient of Variation for litter traits in Desi pigs

Litter traits	Desi	
	Mean ± S.E	CV (percentage)
Birth weight (kg)	0.596 ± 0.012 (223)	20.7
Litter size at birth	9.375 ± 0.394 (24)	20.1
Litter weight at birth (kg)	6.025 ± 0.341 (24)	27.7
Weaning weight (kg)	5.664 ± 0.180 (132)	20.3
Litter size at weaning	5.458 ± 0.544 (24)	48.9
Litter weight at weaning (kg)	30.79 ± 3.09 (24)	49.2

(Values in parenthesis indicate number of observations)

Table 4. Mean, standard error and Co-efficient of Variation for litter traits in Crossbred pigs

Litter traits	Crossbred pigs	
	Mean ± SE	CV (percentage)
Birth weight (kg)	1.018 ± 0.014 (272)	20.9
Litter size at birth	8.437 ± 0.391 (32)	26.2
Litter weight at birth (kg)	8.443 ± 0.419 (32)	28.1
Weaning weight (kg)	8.320 ± 0.415 (207)	23.2
Litter size at weaning	6.406 ± 0.473 (32)	41.7
Litter weight at weaning (kg)	51.40 ± 3.18 (32)	35.0

(Values in parenthesis are number of observations)

Fig.1 Comparison of Birth Weight in Three Genetic Groups

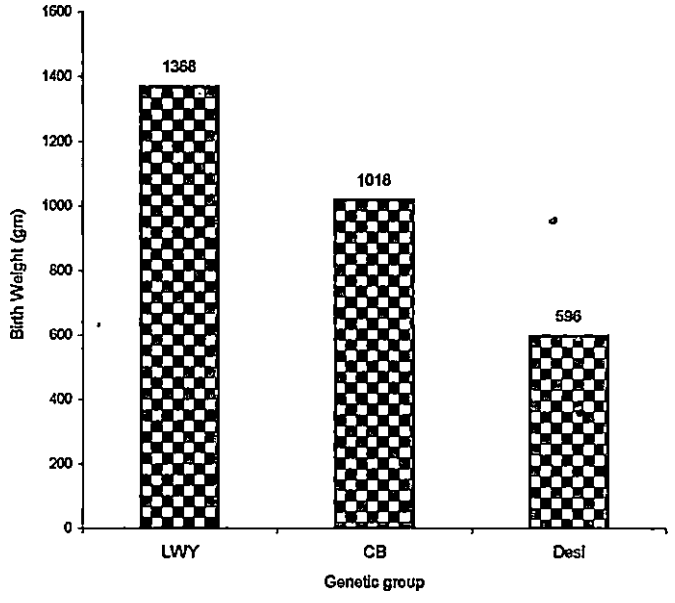

Fig. 2 Comparison of Weaning Weight in Three Genetic Groups

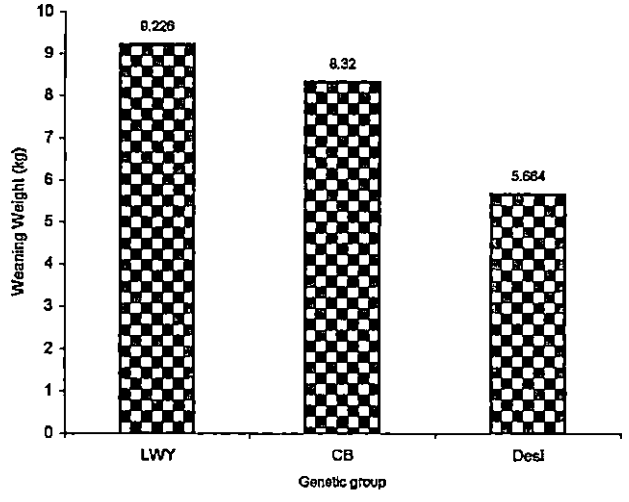

Fig.3 Comparison of Litter Size at Birth in Three Genetic Groups

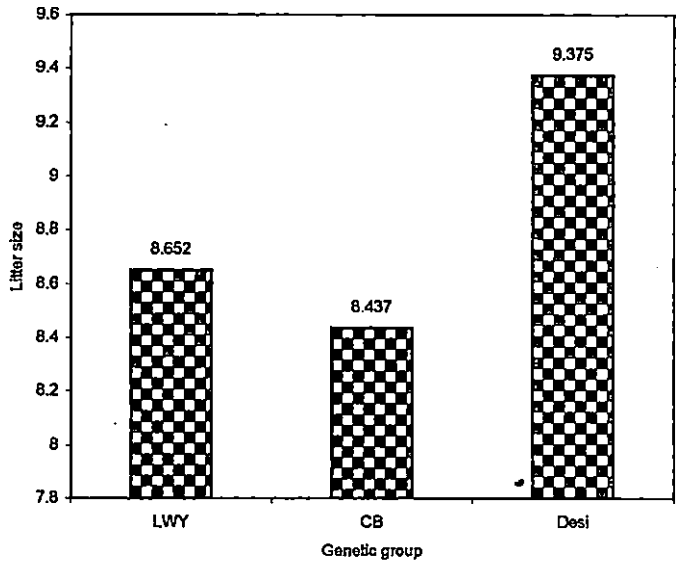

Fig. 4 Comparison of Litter Size at Weaning in Three Genetic Groups

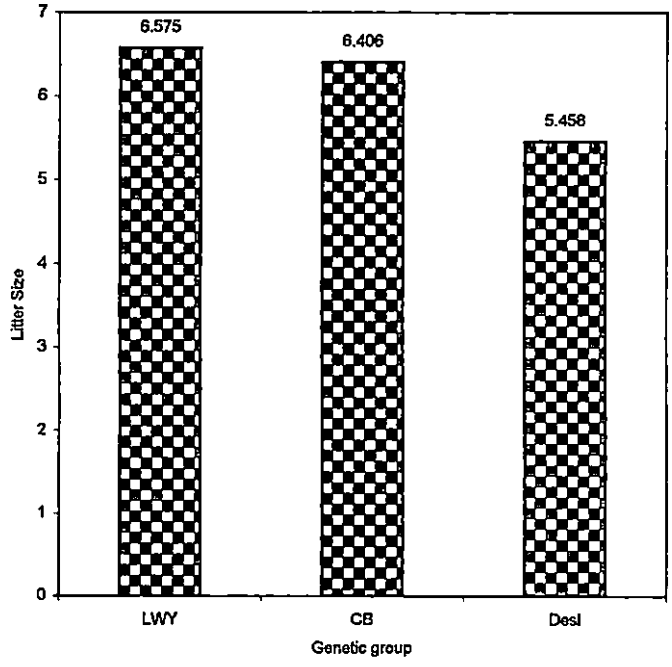

Fig. 5 Comparison of Litter Weight at Birth in Three Genetic Groups

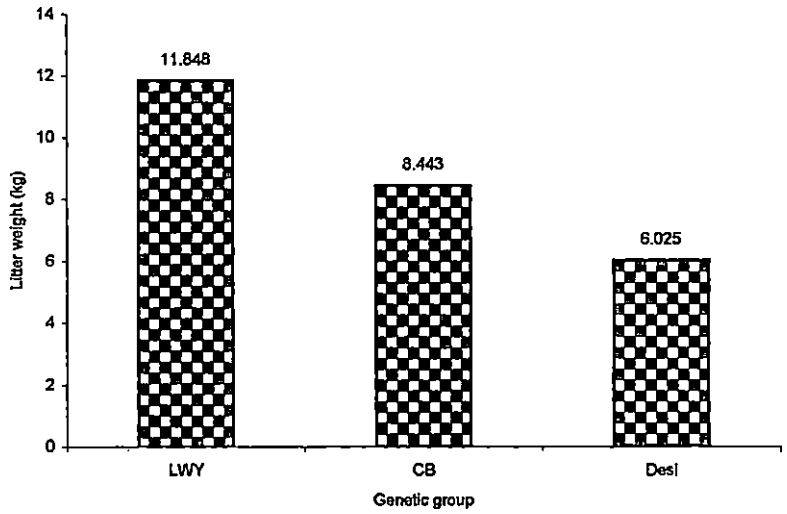

Fig. 6 Comparison of Litter Weight at Weaning in Three Genetic Groups

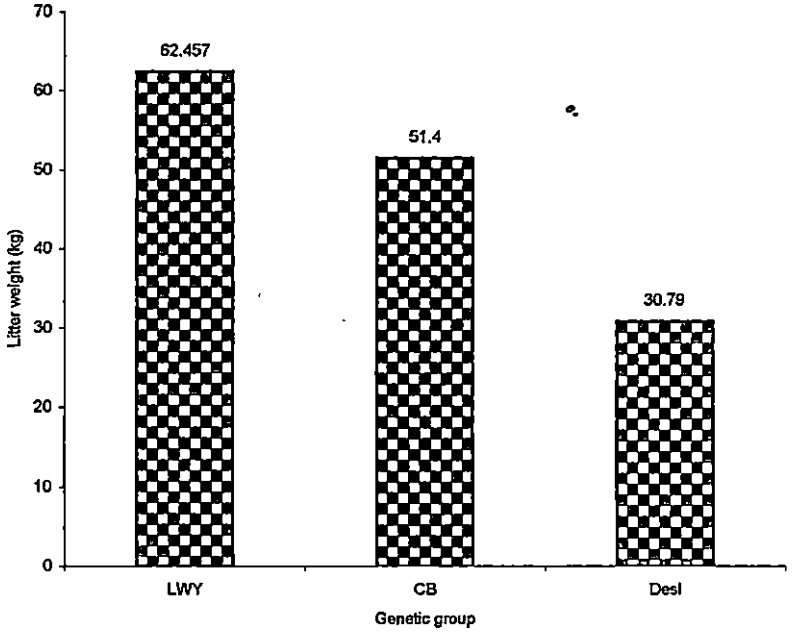

Table 5. Least squares means and standard error for the factors affecting average birth weight in Large White Yorkshire pigs

Factors		Mean ± SE (Kg)
Sex	Male	1.375 ±0.0175 (184)
	Female	1.361 ± 0.0187 (161)
Sire number	1	1.409 ± 0.0336 (44)
	2	1.367 ± 0.0386 (37)
	3	1.375 ± 0.0517 (21)
	4	1.335 ± 0.0518 (21)
	5	1.379 ± 0.0376 (36)
	6	1.362 ± 0.0312 (50)
	7	1.289 ± 0.0553 (16)
	8	1.309 ± 0.0454 (24)
	9	1.423 ± 0.0497 (20)
	10	1.422 ± 0.0344 (42)
	11	1.560 ± 0.0590 (14)
	12	1.184 ± 0.0501 (20)
Litter size at birth		
	≤7	1.397 ± 0.0276 (78)
	8–9	1.409 ± 0.0244 (120)
	≥10	1.298 ± 0.0207 (147)
Overall mean		1.368 ± 0.0135 (345)

(Values in parenthesis indicate number of observations)

Mean = 1.363 Error Standard deviation = 0.217

CV = 15.94 R = 0.413

Table 6. Least squares means and standard error for the factors affecting average birth weight in Desi pigs

Factors		Mean ± SE (Kg)
Sex	Male	0.6105 ± 0.0133 (135)
	Female	0.5831 ± 0.0170 (88)
Sire number	1	0.4945 ± 0.0259 (30)
	2	0.6875 ± 0.0183 (45)
	3	0.5660 ± 0.0226 (40)
	4	0.6321 ± 0.0233 (36)
	5	0.5864 ± 0.0262 (29)
	6	0.5783 ± 0.0357 (12)
	7	0. .6326 ± 0.0251 (31)
Litter size at birth		
	≤ 7	0.4876 ± 0.0333 (18)
	8–9	0.6383 ± 0.0142 (77)
	≥ 10	0.6644 ± 0.0122 (128)
Overall mean		0.5968 ± 0.0126 (223)

(Values in parenthesis indicate number of observations)

Mean = 0.6514 Error Standard deviation = 0.127

CV = 18.66 R = 0.475

Table 7. Least squares means and standard error for the factors affecting average birth weight in Crossbred pigs

Factors		Mean ± SE (Kg)
Sex	Male	1.054 ± 0.0200 (120)
	Female	0.982 ± 0.0175 (152)
Sire number	1	0.912 ± 0.0277 (51)
	2	1.003 ± 0.0413 (24)
	3	0.975 ± 0.0258 (64)
	4	0.989 ± 0.0277 (50)
	5	1.044 ± 0.0378 (30)
	6	1.051 ± 0.0332 (35)
	7	1.154 ± 0.0473 (18)
Litter size at birth		
	< 7	1.029 ± 0.0318 (42)
	8 – 9	1.091 ± 0.0184 (122)
	> 10	0.935 ± 0.0205 (108)
Overall mean		1.018 ± 0.0145 (272)

(Values in parenthesis indicate number of observations)

Mean = 0.996 Error Standard deviation = 0.194

CV = 19.53 R = 0.445

Table 8. Least squares analysis of variance for the effect of sex, sire and litter size at birth on birth weight in three genetic groups

Source of variation	Large white Yorkshire		Desi		Crossbred	
	DF	Mean squares	DF	Mean squares	DF	Mean squares
Sex	1	0.014908	1	0.0373	1	0.34504*
Sire	11	0.140120*	6	0.1188*	6	0.164284*
Litter size at birth	2	0.273798*	2	0.1806*	2	0.611402*
Error	330	0.047205*	213	0.014774	262	0.037735

* $P \leq 0.5$

Table 9. Least squares means and standard error for the factors affecting average weaning weight in Large White Yorkshire pigs

Factors		Mean ± SE
Sex	Male	9.357 ± 0.1940 (139)
	Female	9.094 ± 0.2102 (123)
Sire number	1	10.105 ± 0.3560 (33)
	2	8.539 ± 0.3893 (28)
	3	10.072 ± 0.5602 (14)
	4	7.7067 ± 0.5136 (17)
	5	9.784 ± 0.3590 (34)
	6	10.615 ± 0.3854 (35)
	7	8.719 ± 0.5387 (12)
	8	8.612 ± 0.4751 (17)
	9	9.117 ± 0.4917 (16)
	10	10.372 ± 0.3595 (31)
	11	7.7274 ± 0.5604 (12)
	12	9.338 ± 0.5624 (13)
Litter size at birth		
	≤ 7	9.326 ± 0.3008 (65)
	8–9	8.700 ± 0.2761 (97)
	≥ 10	9.651 ± 0.2467 (100)
Litter size at weaning		
	≤ 5	9.616 ± 0.3476 (39)
	6–7	8.687 ± 0.2135 (122)
	8–9	9.373 ± 0.2727 (101)
Birth weight		
	≤ 1.0	8.425 ± 0.4693 (18)
	1.01 – 1.25	9.155 ± 0.2511 (59)
	1.26 – 1.50	9.459 ± 0.1935 (106)
	≥ 1.51	9.863 ± 0.2314 (79)
Over all mean		9.226 ± 0.1671 (262)

(Values in parenthesis indicate number of observations)

Mean = 9.552 Error Standard deviation = 1.79

CV = 18.81 R = 0.374

Table 10. Least squares means and standard error for the factors affecting average weaning weight in Desi pigs

Factors		Mean ± SE
Sex	Male	5.647 ± 0.188 (81)
	Female	5.681 ± 0.251 (51)
Sire number	1	5.682 ± 0.268 (22)
	2	6.131 ± 0.237 (29)
	3	5.470 ± 0.315 (19)
	4	6.565 ± 0.270 (24)
	5	5.312 ± 0.302 (19)
	6	5.553 ± 0.410 (7)
	7	4.935 ± 0.359 (12)
Litter size at birth		
	≤ 7	6.230 ± 0.369 (10)
	8–9	5.716 ± 0.218 (49)
	≥ 10	5.045 ± 0.205 (73)
Litter size at weaning		
	≤ 5	5.746 ± 0.227 (33)
	6–7	5.393 ± 0.250 (38)
	8-9	5.852 ± 0.217 (61)
Birth weight		
	≤ 0.5	5.280 ± 0.466 (5)
	0.51 – 0.70	5.692 ± 0.169 (75)
	0.71 – 1.0	6.019 ± 0.197 (52)
Overall mean		5.664 ± 0.180 (132)

(Values in parenthesis indicate number of observations)

Mean = 5.670 Error Standard deviation = 0.984

CV = 17.35 R = 0.584

Table 11. Least squares means and standard error for the factors affecting average weaning weight in Crossbred pigs

Factors		Mean ± SE
Sex	Male	8.430 ± 0.184 (89)
	Female	8.216 ± 0.167 (118)
Sire number	1	7.399 ± 0.317 (28)
	2	9.253 ± 0.362 (18)
	3	8.516 ± 0.2125 (55)
	4	7.853 ± 0.239 (38)
	5	7.694 ± 0.309 (26)
	6	9.189 ± 0.287 (29)
	7	8.336 ± 0.443 (13)
Litter size at birth		
	≤ 7	8.568 ± 0.285 (35)
	8–9	8.382 ± 0.189 (84)
	≥ 10	8.009 ± 0.218 (88)
Litter size at weaning		
	≤ 5	9.222 ± 0.255 (42)
	6–8	8.590 ± 0.178 (70)
	9–11	7.147 ± 0.261 (95)
Birth weight		
	≤ 0.75	7.098 ± 0.392 (16)
	0.76 – 1.0	8.246 ± 0.158 (106)
	1.1 – 1.25	8.871 ± 0.195 (57)
	1.26 – 1.90	9.064 ± 0.305 (28)
	Overall mean	8.320 ± 0.145 (207)

(Values in parenthesis indicate number of observations)

Mean = 8.0636 Error Standard deviation = 1.366

CV = 16.94 R = 0.703

Table 12. Least square analysis of variance for the effect of sex, sire, litter size at birth, litter size at weaning and birth weight on weaning weight in three genetic groups of pigs

Source of variation	Large white Yorkshire		Desi		Crossbred	
	DF	Mean squares	DF	Mean squares	DF	Mean squares
Sex	1	4.270085	1	0.03499	1	2.294634
Sire	11	13.212313*	6	4.82753*	6	11.605995*
Litter size at birth	2	12.705025*	2	7.25294*	2	2.395278*
Litter size at weaning	2	12.220407*	2	1.55764	2	32.807399*
Birth weight	3	10.637051*	2	1.78369	3	13.993583*
Error	242	3.229782	118	0.96830	192	1.866891

* $P \leq 0.5$

Table 13. Mean, standard error and co-efficient of variation for pre-weaning mortality in three genetic groups

Genetic groups	Mean ± SE	CV (percentage)
Large White Yorkshire	26.63 + 0.180 (40)	55.5
Desi	37.952 + 0.397 (24)	50.2
Crossbred pigs	23.598+ 0.301 (32)	61.7

(Values in parenthesis indicate number of observations)

Table 14. Analysis of variance for the effect of genetic group on average birth weight

Source of variation	Degrees of freedom	Sum of Squares	Mean sum of squares	F value
Between groups	2	70.01	35.006	839.25**
Within groups	836	34.87	0.042	
Total	838	104.884		

** $P \leq 0.01$

Table 15. Analysis of variance for the effect of genetic group on average weaning weight

Source of variation	Degrees of freedom	Sum of Squares	Mean sum of squares	F value
Between groups	2	1313.84	656.92	203.915**
Within groups	598	1926.47	3.22	
Total	600	3240.31		

** $P \leq 0.01$

Table 16. Analysis of variance for the effect of genetic group on litter size at birth

Source of variation	Degrees of freedom	Sum of Squares	Mean sum of squares	F value
Between groups	2	12.889	6.445	1.709^{NS}
Within groups	93	350.6	3.769	
Total	95	33.489		

NS = Non significant

Table 17. Analysis of variance for the effect of genetic group on litter size at weaning

Source of variation	Degrees of freedom	Sum of Squares	Mean sum of squares	F value
Between groups	2	20.037	10.019	1.927^{NS}
Within groups	93	483.452	5.198	
Total	95	503.489		

NS = Non significant

Table 18. Analysis of variance for the effect of genetic group on litter weight at birth

Source of variation	Degrees of freedom	Sum of Squares	Mean sum of squares	F value
Between groups	2	540.492	270.246	59.97^{**}
Within groups	93	419.065	4.506	
Total	95	959.557		

** $P \leq 0.01$

Table 19. Analysis of variance for the effect of genetic group on litter weight at weaning

Source of variation	Degrees of freedom	Sum of Squares	Mean sum of squares	F value
Between groups	2	15055.45	7527.725	27.768**
Within groups	93	25210.84	271.084	
Total	95	40266.29		

** $P \leq 0.01$

Table 20. Analysis of variance for the effect of genetic group on pre-weaning mortality

Source of variation	Degrees of freedom	Sum of Squares	Mean sum of squares	F value
Between groups	2	6157.552	3078.775	6.256**
Within groups	93	45762.536	492.070	
Total	95	51920.088		

** $P \leq 0.01$

Table 21. Average fortnightly body weight (kg) in Large White Yorkshire, Desi and Crossbred pigs

Age in fortnights	Large White Yorkshire	Desi	Crossbred pigs
Initial weight	8.662 ± 0.181	6.0 ± 0.361	9.215 ± 0.567
I	13.750 ± 0802	7.387 ± 0.276	13.625 ± 0.540
II	16.437 ± 1.123	8.825 ± 0.593	16.50 ± 0.619
III	20.062 ± 1.602	11.5 ± 0.767	19.812 ± 0.839
IV	24.125 ± 1.882	14.687 ± 1.093	23.375 ± 1.220
V	29.625 ± 1.935	18.0 ±1.164	28.375 ± 1.435
VI	42.875 ± 2.531	20.75 ± 1.448	37.250 ± 1.790
VII	48.062 ± 2.877	24.0 ±2.0	41.250 ± 2.057
VIII	53.750 ± 3.20	26.25 ± 1.959	46.812 ± 2.456
IX	59.50 ± 3.005	29.25 ± 1.970	51.25 ± 2.932
X	64.250 ± 2.962	30.75 ± 2.234	54.125 ± 3.170
XI	69.50 ± 3.484	33.312 ± 2.076	59.875 ± 3.656
XII	76.50 ± 3.950	36.875 ± 1.757	66.625 ± 4.013

Fig. 7 Comparison of Growth Performance in Three Genetic Groups

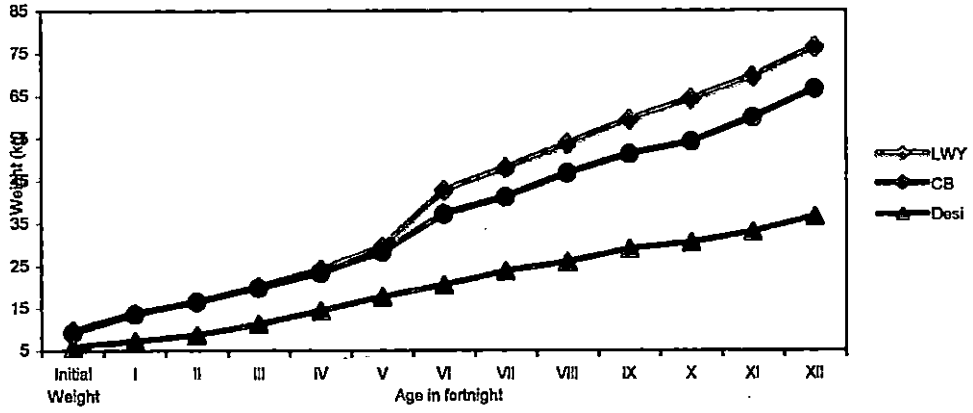

Fig. 8 Comparison of Average Daily Gain in Three Genetic Groups

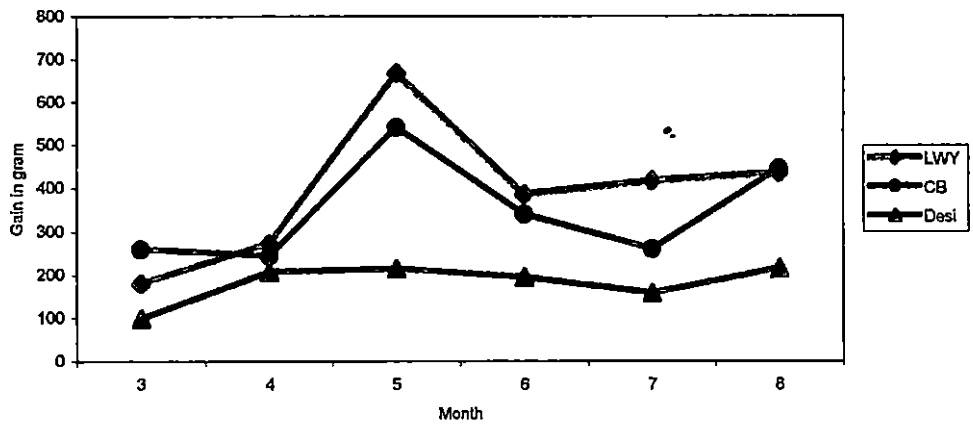

Table 22. Average daily gain in weight (gm) of Large White Yorkshire, Desi and Crossbred pigs

Month	Large White Yorkshire	Desi	Crossbred pigs
Third month	0.181 ± 0.024	0.100 ± 0.010	0.260 ± 0.029
Fourth month	0.274 ± 0.035	0.209 ± 0.029	0.245 ± 0.030
Fifth month	0.669 ± 0.025	0.216 ± 0.017	0.541 ± 0.027
Sixth month	0.388 ± 0.038	0.196 ± 0.026	0.341 ± 0.033
Seventh month	0.419 ± 0.048	0.160 ± 0.019	0.261 ± 0.028
Eighth month	0.437 ± 0.050	0.218 ± 0.029	0.446 ± 0.041

Table 23. Analysis of variance for the effect of genetic group on body weight at third month of age

Source of variation	Degrees of freedom	Sum of Squares	Mean sum of squares	F value
Between groups	2	269.625	134.812	16.51**
Within groups	21	171.403	8.162	
Total	23	441.028		

** $P \leq 0.01$

Table 24. Analysis of variance for the effect of genetic group on body weight at fifth month of age

Source of variation	Degrees of freedom	Sum of Squares	Mean sum of squares	F value
Between groups	2	2115.75	1057.87	33.87**
Within groups	21	655.87	31.232	
Total	23	2771.62		

** $P \leq 0.01$

Table 25. Analysis of variance for the effect of genetic group on body weight at eighth month of age

Source of variation	Degrees of freedom	Sum of Squares	Mean sum of squares	F value
Between groups	2	6237.30	3118.62	32.92**
Within groups	21	1989.4	94.732	
Total	23	8226.7		

** $P \leq 0.01$

Table 26. Analysis of variance for the effect of genetic group on third month body weight in Large White Yorkshire and Crossbred pigs

Source of variation	Degrees of freedom	Sum of Squares	Mean sum of squares	F value
Between groups	1	0.0156	0.156	0.0023^{NS}
Within groups	14	92.218	6.587	
Total	15	92.2336		

NS = Non significant

Table 27. Total feed intake (Kg)in Large White Yorkshire, Desi and Crossbred pigs during different ages

Month	Large White Yorkshire	Desi	Crossbred pigs
Third month	282.40	109.20	270.7
Fourth month	332.50	134.70	292.35
Fifth month	412.00	232.75	363.30
Sixth month	480.80	305.15	424.20
Seventh month	542.20	312.45	464.45
Eighth month	600.00	365.70	530.40
Total	2649.90	1459.95	2345.4

Table 28. Average feed conversion efficiency in Large White Yorkshire, Desi and Crossbred pigs during different ages.

Month	Large White Yorkshire	Desi	Crossbred pigs
Third month	8.198 ± 1.375	5.222 ± 0.531	5.028 ± 0.498
Fourth month	6.066 ± 0.791	3.265 ± 0.424	6.413 ± 1.262
Fifth month	2.773 ± 0.104	5.028 ± 0.422	3.750 ± 0.256
Sixth month	6.032 ± 0.753	8.910 ± 2.401	5.993 ± 0.665
Seventh month	6.220 ± 0.600	9.631 ± 1.139	9.056 ± 1.563
Eighth month	6.840 ± 0.735	8.402 ± 1.017	5.688 ± 0.609

Table 29. Mean and standard errors of carcass traits in Large White Yorkshire, Desi and Crossbred pigs

Parameters	Large white Yorkshire	Desi	Crossbred
Carcass weight (kg)	58.5 ± 3.27	23.1 ± 1.48	46.8 ± 3.16
Carcass length (cm)	65.0 ± 0.57	44.0 ± 0.42	58 ± 0.6
Back fat thickness (cm)	3.56 ± 0.19	2.44 ± 0.13	3.2 ± 0.31
Loin eye area(cm^2)	20.8 ± 0.75	12.9 ± 0.59	17.9 ± 0.57
Dressing percentage (%)	76.2 ± 0.69	60.2 ± 0.72	71.1 ± 0.69
Weight of gut (kg)	10.3 ± 0.62	5.30 ± 0.59	7.75 ± 0.60
Weight of feet (kg)	1.53 ± 0.05	0.98 ± 0.13	1.43 ± 0.05
Weight of head (kg)	6.36 ± 0.50	4.3 ± 0.12	5.13 ± 0.18
Weight of internal organs (kg)	3.19 ± 0.13	1.97 ± 0.06	2.87 ± 0.09

Fig. 9 Comparison of Carcass Traits in Three Genetic Groups

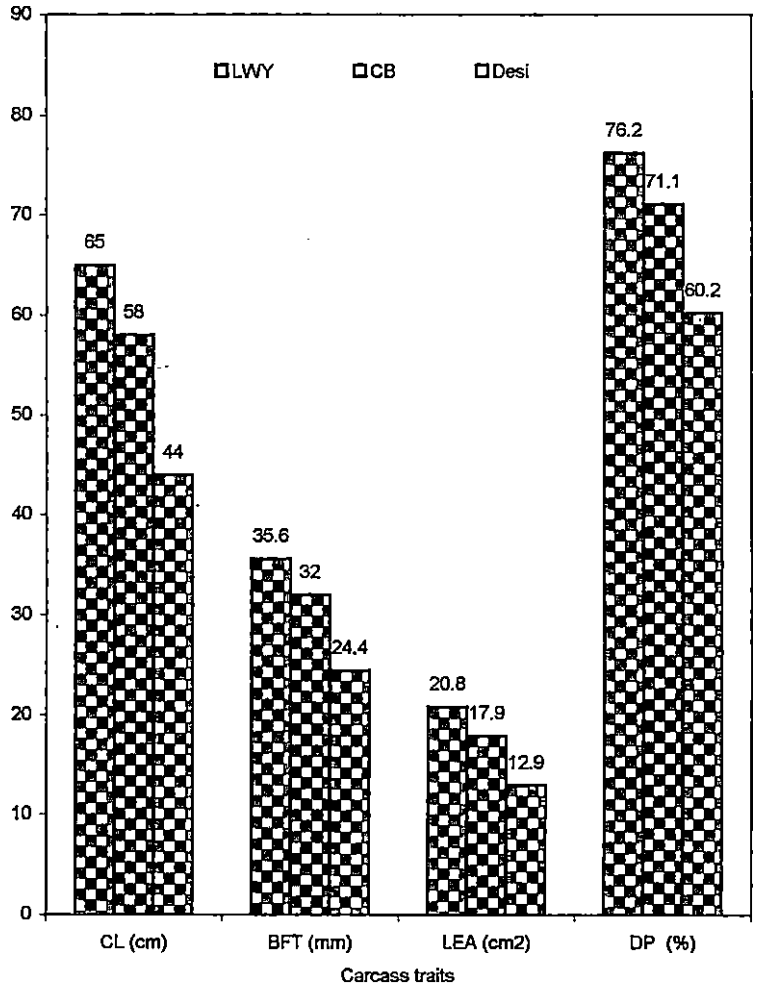

Table 30 Analysis of variance for the effect of genetic group on dressing percentage

Source of variation	Degrees of freedom	Sum of Squares	Mean sum of squares	F value
Between groups	2	1073.24	536.62	136.23**
Within groups	21	82.72	3.94	
Total	23	1155.96		

** $P \leq 0.01$

Table 31. Analysis of variance for the effect of genetic group on back fat thickness

Source of variation	Degrees of freedom	Sum of Squares	Mean sum of squares	F value
Between groups	2	5.28	2.64	6.71**
Within groups	21	8.26	0.39	
Total	23	13.54		

** $P \leq 0.01$

Table 32. Analysis of variance for the effect of genetic group on loin eye area

Source of variation	Degrees of freedom	Sum of Squares	Mean sum of squares	F value
Between groups	2	220.56	110.28	33.27**
Within groups	21	69.59	3.31	
Total	23	290.15		

** $P \leq 0.01$

Table 33. Analysis of variance for the effect of genetic group on carcass length

Source of variation	Degrees of freedom	Sum of Squares	Mean sum of squares	F value
Between groups	2	218.89	109.44	46.11**
Within groups	21	49.84	2.37	
Total	23	268.73		

** $P \leq 0.01$

Table 34. Cost of production per kg live body weight in Large White Yorkshire, Desi and Crossbred pigs

Observation	Large White Yorkshire	Crossbred	Desi
Number of animals	8	8	8
Total intial body weight (kg)	69.30	73.70	48.0
Total final body weight (kg)	612.0	533.0	295.0
Total body weight gain (kg)	542.70	459.30	247.0
Total feed consumed in first three months (18% CP) kg	1029.8	925.75	576.52
Total feed consumed in last three months (14% CP) kg	1619.3	1419.7	883.43
Total feed intake (kg)	2649.1	2345.45	1459.95
Cost of feed/kg for 18% crude protein (Rs.)	7.55	7.55	7.55
Cost of feed/kg for 14% crude protein (Rs.)	7.02	7.02	7.02
Feed cost for 18% CP (Rs.)	7772.99	6989.41	4352.73
Feed cost for 14% CP (Rs.)	11367.45	9966.29	6201.68
Total feed cost(Rs.)	19140.48	16955.70	10554.41
Cost of 1kg feed (Total feed cost/ Total feed intake)	7.22	7.22	7.22
Feed conversion efficiency	4.881	5.106	5.910
Cost of production on feed basis (Rs.) (FCR x Cost of feed/kg)	35.28	36.86	42.67
Cost of production/ kg meat* (Rs.)	47.04	49.15	56.89

* = Under the assumptions that cost of feed accounts for about 75 per cent of total cost of production in pigs(Mathew,1997)

Discussion

5. DISCUSSION

The sow productivity has an important influence on efficiency in a swine enterprise. It is a composite of several traits including ovulation rate, conception rate and the sows ability to farrow live piglets. In addition, the sow contributes to her litters survival and growth through direct genetic effect and the maternal environment she provides.

There is a positive correlation between birth weight and weaning weight. The market weight of litter is the most important economic trait and this depends on litter traits. Hence, a comparison of genetic groups for litter traits will aid in deciding a breeding strategy.

The results obtained during the course of the present study are discussed below.

5.1 Litter traits

The mean of litter traits such as birth weight, weaning weight, litter size at birth and weaning, litter weight at birth and weaning for Large White Yorkshire were 1.368 ± 0.013kg,

9.226 ± 0.167 kg 8.652 ± 0.269 and 6.575 ± 0.257, 11.848 ± 0.34 and 62.457 ± 0.25kg. These values are comparable to those reported by Singh *et al.* (1990a, b), except for weaning weight, and Singh *et al.* (1986). Further, the present findings excelled the values reported by Chatterjee *et al.* (1988), Mathew (1997) and Ramesh (1998) and while Mishra *et al.* (1990a), Lakhani (1992) reported higher values.

Litter traits of Desi pigs averaged 0.596 ± 0.12 kg for birth weight, 5.664 ± 0.180 kg for weaning weight, 9.375 ± 0.394 for litter size at birth and weaning (5.458 ± 0.544), 6.025 ± 0.34 for litter weight at birth and weaning (30.79 ± 3.09kg). However Gaur *et al.* (1996), Jogi and Johar (1994) reported higher values. These results are in close proximity with the reports of Mathew (1997) for litter size at weaning and litter weight at weaning and that of Goswami *et al* (1999) for litter size at weaning and Lakhani (1988) for litter weight at weaning. But higher values were reported earlier by Singh and Devi (1997a, b) for birth weight and weaning weight.

The overall average birth weight, weaning weight, litter size at birth and weaning, litter weight at birth and weaning were 1.018 ± 0.014 kg, 8.320 ± 0.145 kg, 8.437 ± 0.391 and 6.406 ± 0.473, 8.443 ± 0.419 and 51.40 ± 3.18 kg respectively for Large

White Yorkshire and Desi Crossbred pigs. Similar observations were made by Dash and Mishra (1986), Sharma *et al.* (1992) and Chatterjee *et al.* (1987) expect for weaning weight and litter weight at weaning. These findings do not agree with the observations made by Chatterjee *et al.* (1988), Lakhani and Jogi (1988) and Das and Gaur (1999), while Bhargava *et al.* (1999) reported higher litter weight at birth and litter weight at weaning.

For all litter traits except litter size at birth, Large White Yorkshire performed better followed by Crossbred pigs and Desi, as also reported by Sharma *et al.* (1990). Desi pigs had higher litter size at birth compared to Large White Yorkshire and Crossbred pigs. This indicate that Desi pigs are tolerant to heat stress. Heat stress may be responsible for early embryonic mortality in Large White Yorkshire.

In the present study, the co-efficient of variation for all litter traits were almost 20 per cent. The traits are more variable in Desi pigs followed by Crossbred and Large White Yorkshire probably due to the small sample size. Variation in observations from other reports might possibly be due to the following reasons.

1. Difference in genetic groups.
2. Rearing pigs under different climatic, nutritional and managemental conditions.

5.1.1 Effect of different factors on birth weight in three genetic groups

Sex had no significant effect on birth weight in Large White Yorkshire and Desi pigs. Similar observations were also made by Rai and Desai (1985) for Large White Yorkshire and Mishra *et al.* (1989b), Mukhopadhyay *et al.* (1991), Deo *et al.* (1992) for Desi pigs. However, these results do not agree with these of Mishra *et al.* (1990c) for Large White Yorkshire and Shylla *et al.* (1991) for Desi pigs.

In the present study, sex was a significant source of variation for birth weight in Crossbred pigs in contrast to the report by Sharma *et al.* (1990).

Sire effect was highly significant for birth weight in all the three genetic groups. Similar observations were made by Lakhani and Jogi (1998) in Large White Yorkshire, Desi and Crossbred pigs.

Least squares analysis revealed that litter size at birth had a significant effect on birth weight in all three genetic groups.

A general trend of decrease in birth weight was observed when litter size at birth increased. This could be due to the lower availability of nutrients for developing foetus at later stages of gestation and less availability of uterine space.

Significant effect of litter size at birth on birth weight was documented by Mishra *et al.* (1989b), Gaur *et al.* (1996) in Desi pigs.

5.1.2 Effect of different factors on weaning weight in three genetic groups

There was no significant effect of sex on weaning weight in three genetic groups. This result agree with the reports of Sharma *et al* (1990) in Large White Yorkshire, Desi and Crossbred pigs. But Rai and Desai (1985) observed significant effect of sex on weaning weight in Large White Yorkshire. Lakhani and Bhadoria (1988), and Shylla *et al.* (1991), Deo *et al.* (1992) observed similar results in Desi pigs.

In all three genetic groups, influence of sire on weaning weight was found to be significant ($P \leq 0.05$). Gupta

et al. (1983) and Jogi and Johar (1994) observed similar results in Large White Yorkshire and Desi pigs respectively.

Litter size at birth was found to have significant effect on weaning weight in three genetic groups. This observation agrees with the findings of Chatterjee *et al.* (1988), Lakhani (1992) for Large White Yorkshire and Mukhopadhyay *et al.* (1991), Gaur *et al.* (1996) for Desi pigs.

Least square analysis of variance revealed significant effect of litter size at weaning on weaning weight in Large White Yorkshire and Crossbred pigs, but not in Desi pigs. The same results are reported by Sharma *et al.* (1992) in crossbred pigs.

It is noticed that as litter size at weaning increased the average weaning weight of pigs decreased. Higher litter size at weaning is always advantageous because of increase in total litter weight at weaning.

Birth weight had been a significant source of variation for weaning weight in Large White Yorkshire and Crossbred pigs, but no significant effect was noticed in Desi pigs. A positive correlation was noticed between birth weight and weaning weight

in all the three genetic groups. Chatterjee *et al.* (1988) attributed similar results in Large White Yorkshire.

5.2 Pre-weaning mortality

pre-weaning mortality in Large White Yorkshire, Desi and Crossbred pigs were 26.63 ± 0.180 per cent, 37.952 ± 0.397 and 23.598 ± 0.301 per cent respectively.

Similar finding was observed by Singh *et al.* (1986) and Mathew (1997) in Large White Yorkshire. However, Chakrabarti and Basak (1986) reported higher values in Large White Yorkshire. This result is also higher than the observation made by Chatterjee *et al.* (1987) and Chatterjee *et al.* (1988) in Large White Yorkshire.

In Desi pigs, the results are in close proximity with the reports by Kumar *et al.* (1990). Further, the present estimate was higher than the means given by Prasad *et al.* (1987), Lal *et al.* (1988) and Mathew (1997), while Jogi *et al.* (1993b) reported higher value.

Similar observation was noticed by Chatterjee *et al.* (1988) in Crossbred pigs, but higher values were obtained by

Chatterjee *et al.* (1987) in 75 per cent Crossbred pigs and lower values by Pandey *et al.* (1995).

In Large White Yorkshire, the pre-weaning mortality was mostly due to crushing in the first week of life as suggested by Chakarabarti and Basak (1986). In Desi pigs as litter size at birth was higher, the individual piglet birth weight was around 0.5 gm, which predisposed for the increase in pre-weaning mortality. Better managemental practices would reduce the pre-weaning mortality. This is in concurrence with the reports of Sadana and Singh (1972). The pre-weaning mortality had higher environmental effect rather than genetic effect as observed by Jogi *et al.* (1993b).

In this study, Crossbreds showed higher survival rate compared to Large White Yorkshire and Desi pigs probably due to heterotic effect.

5.3 Effect of genetic group on litter traits

Analysis of variance revealed that genetic group had a significant ($P \leq 0.01$) effect on birth weight, weaning weight, litter weight at birth and weaning and pre-weaning mortality. But no significant effect of genetic group was observed for litter size at birth and weaning.

Singh *et al.* (1990 a,b), Bhargava *et al.* (1999) reported a significant effect of genetic group on all litter traits. Deo *et al.* (1979) observed significant effect only for litter size at weaning and not for litter size at birth, litter weight at birth and weaning in Large White Yorkshire, Desi and Crossbred pigs.

Pandey *et al.* (1995) and Singh *et al.* (1997b) concluded that the genetic group had significant effect on pre-weaning mortality and birth weight respectively in all three genetic groups. Lakhani and Jogi (1988) observed no significant effect on birth weight in Desi pigs.

5.4 Growth

The mean body weight at sixth, eighth, tenth and twelth fortnights for Large White Yorkshire were 42.875 ± 2.531kg, 53.750 ± 3.20kg, 64.250 ± 2.962 and 76.50 ± 3.950kg respectively. Average daily gain in weight of Large White Yorkshire averaged as 0.669 ± 0.025gm, 0.388 ± 0.038gm, 0.419 ± 0.048 and 0.437 ± 0.050gm respectively for fifth, sixth, seventh and eight months of age. The fortnightly body weight for Large White Yorkshire in the present study are comparable to those reported by Chatterjee *et al.* (1988), Pradhan (1993) and higher values were recorded by Jayarajan and Ulaganathan (1992)

for body weight. In case of average daily gain in weight, lower ADG was reported by Leena (1992) and Kannan (1995) in Large White Yorkshire.

The body weight of Desi pigs averaged 20.75±1.448kg, 26.25 ± 1.959kg, 30.75 ± 2.234 and 36.875 ± 1.757kg respectively for sixth, eighth, tenth and 12th fortnights respectively. The average daily gain for fifth, sixth, seventh and eighth months were 0.216 ± 0.017gm, 0.196 ± 0.026gm, 0.160 ± 0.019 and 0.218 ± 0.029gm respectively in Desi pigs. Gaur *et al.* (1997) observed the similar body weight for Desi pigs as in the present study. But the AICRP Report (1997) indicated that different centres showed difference in bodyweight at 32nd week. The variation in body weight for Desi pigs at different centres could be due to difference in genetic makeup, managemental and nutritional aspects prevailing in the centres. Higher average daily gain in weight was noticed by Chauhan *et al.* (1993) for Desi pigs at Izatnagar.

The mean body weights at sixth (37.25 ± 1.790kg), eighth (46.812 ± 2.456kg), tenth (54.125 ± 3.170) and 12th (66.625 ± 4.013kg) fortnights were recorded and average daily gain in weight for fifth month (0.541 ± 0.027gm), sixth month (0.341 ± 0.033gm), seventh month (0.261 ± 0.028) and eighth

month (0.446 ± 0.041gm) were observed for Crossbred pigs. The body weight of Crossbred pigs in this study has excelled the means given by Dash and Mishra (1986), Chatterjee *et al.* (1987) and Sharma *et al.* (1990).

In this study, the fortnightly body weight was similar from weaning to third month of age, in Large White Yorkshire and Crossbred pigs, after that significant body weight difference was noticed till the slaughter age. This may be due to the better mothering ability inherited from Desi together with the hybrid vigour resulting in Crossbreds. The maximum ADG was noticed in all three genetic groups during fifth month. This finding is an agreement with reports of Suraj (2000). This calls for better feeding and management during this period for maximum exploitation of growth potential of three genetic groups.

The growth studies indicate that, higher body weight and average daily gain were in Large White Yorkshire followed by Crossbred and Desi pigs in all fortnights. Similar finding has been observed in Gaur *et al.* (1996), Chatterjee *et at.* (1988).

5.5 Effect of genetic group on growth

Genetic group had significant effect ($P \leq 0.01$) on third, fifth and eighth months body weight in all three genetic

171714

groups, which is endorsed by Kumar *et al.* (1990), Mukhopadhyay *et al.* (1991) and Singh *et al.* (1997b), Deo *et al.* (1992) and Gaur *et al.* (1996). But, there was no significant difference between Large White Yorkshire and Crossbred for third month body weight. These findings are in agreement with that of Suraj (2000).

5.6 Feed conversion efficiency

Computation of feed conversion efficiency on monthly basis showed that highest value was noticed at fifth month of age for Large White Yorkshire (2.733 ± 0.104) and Crossbred pigs (3.750 ± 0.256). However, in Desi pigs highest feed conversion efficiency was during the fourth month (3.265 ± 0.424). The feed efficiency decreased with increase in the age, which is endorsed by Dash and Mishra (1986), Singh *et al.* (1990a) and Kumar *et al.* (1990), Suraj (2000) in all three genetic groups but Singh *et al.* (1990a) observed as increasing of FCE with increase of age.

In Large White Yorkshire, higher values were reported by Singh *et al.* (1994), Kannan (1995) and Suraj (2000). However, lower value was reported by Mathew (1997) in Large White Yorkshire. Comparable feed efficiency values were reported by Singh *et al.* (1994) in Desi male pigs and lower values by Suraj (2000). Higher values were noticed by Singh *et al.* (1994) and Suraj (2000) in Crossbred pigs.

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In the present study, the overall feed conversion efficiency values were estimated. Large White Yorkshire pigs showed highest feed conversion efficiency of (1:4.8) followed by Crossbred pigs (1:5.1), Desi (1:5.9) from weaning to eight month of age, which is agreement with reports of Suraj (2000) in three genetic groups.

5.7 Carcass characteristics

In Large White Yorkshire, back fat thickness, loin eye area and dressing percentage were 3.56 ± 0.19 cm, 20.8 ± 0.75cm^2 and 76.2 ± 0.69 percentage respectively. But lower back fat thickness and higher loin eye area, lower dressing percentage were reported by Leena (1992), Sasidharan (1997), Mathew (1997) in Large White Yorkshire. However, lower back fat thickness, lower loin eye area and lower dressing percentage were reported by Hicks *et al.* (1998) in Large White Yorkshire.

In case of Desi pigs, back fat thickness, loin eye area and dressing percentage observed were 2.44 ± 0.13 cm, 12.9 ± 0.59cm^2 and 60.2 ± 0.72 respectively. According to AICRP Report (1997), higher dressing percentage, higher loin eye area and higher carcass length were noticed in all centres. However, higher back fat thickness and lower dressing percentage were reported by

Jogi *et al.* (1993a) and Singh and Singh (1985) respectively in Desi pigs.

The average value of back fat thickness, loin eye area and dressing percentage for Crossbred pigs in the present study were 3.2 ± 0.31 cm, 17.9 ± 0.57 cm^2 and 71.1 ± 0.69 percentage respectively. But lower back fat thickness was reported by Dash and Mishra (1986), Singh *et al.* (1997a) and lower dressing percentage by Bhattacharyya and Sundaram (1988) in Crossbred pigs.

In conclusion, the dressing percentage and back fat thickness were found to increase with slaughter weight. This indicate that heavy weight groups have high per cent of fat in the carcass. The Large White Yorkshire excelled the Crossbred and Desi pigs in all carcass traits.

5.8 Effect of genetic group on carcass traits

Genetic groups differed significantly ($P \leq 0.01$) for dressing percentage, back fat thickness, loin eye area and carcass length. This is not in agreement with the reports of Samanta *et al.* (1995) but Singh *et al.* (1997a) attributed similar result in all three genetic groups.

5.9 Cost of production per kg of live body weight

Calculation of cost of production per kg of live body weight in three genetic groups depend upon several factors like, total feed intake, feed cost and FCE and total weight gain from weaning to eighth month of age.

It can be seen from Table - 34 that the cost of production per kg of live body weight in Large White Yorkshire, Crossbred and Desi pigs were Rs. 47.04, Rs. 49.15 and Rs. 56.85 respectively. Similar result was observed by Mathew (1997) and Suraj (2000).

The total feed consumption in Desi and Crossbred pigs were lower than Large White Yorkshire, indicating the suitability of these breeds to small holder production system with less resource potential. Large White Yorkshire pigs with better growth rate, feed conversion efficiency and carcass characteristics may be recommended for large and modern commercial piggery units.

5.10 Breeding strategy

In this study to decide a breeding strategy, the following factors are considered for Large White Yorkshire, Desi and Crossbred pigs.

Genetic group comparison indicate that Large White Yorkshire better than Desi and Crossbred pigs for the litter traits, average birth weight and average weaning weight, litter size at weaning, litter weight at birth and weaning. Crossbred pigs had lower pre-weaning mortality and Desi had higher litter size at birth when compared to Large White Yorkshire.

There was no significant difference between body weight for Large White Yorkshire and Crossbred pigs from weaning to fifth month of age, but significant difference in body weight was observed upto slaughter age. Desi pigs showed poor body weight when compared to Large White Yorkshire and Crossbred pigs. Considering carcass traits Large White Yorkshire had higher dressing percentage, loin eye area and back fat thickness than other genetic groups. Crossbred pigs were intermediate between Large White Yorkshire and Desi pigs for all carcass traits.

The significant difference was noticed between Large White Yorkshire, Crossbred and Desi pigs for all litter, growth and carcass traits.

The cost of production per kg of live body weight is lower for Large White Yorkshire followed by Crossbred and Desi

pigs. But the amount of total feed intake and feed cost is higher for Large White Yorkshire and lower for Desi and Crossbred pigs. So for the farmer with limited resources, rearing of Crossbred and Desi pigs are affordable when compared to Large White Yorkshire.

The performance of basic stock of Large White Yorkshire was found to be better both for litter and production traits indicating deterioration in further generations. This might be due to stress of adoption to the environment. Large White Yorkshire cannot tolerate high humidity and heat stress. Heat stress may be responsible for early embryonic mortality in Large White Yorkshire leading to lower litter size at birth. But, Desi pigs have highest litter size at birth indicating better adoption to adverse climatic conditions and heat stress.

So, optimum feeding and managemental conditions are needed for full exploitation of the growth potential of Large White Yorkshire. In view of all above factors, breeding of Desi and Crossbred pigs can be recommended for small scale farmers with limited resources. Large White Yorkshire is most suitable under commercial and organised farming to exploit the growth potential.

Summary

6. SUMMARY

1. The objective of the present investigation was to evaluate the litter traits in Large White Yorkshire, Desi and their Crossbred pigs and to decide a breeding strategy.

2. A minimum of 20-25 farrowings was assigned to three genetic groups for the study on litter traits. All three genetic groups were maintained under similar managemental and housing conditions prevailing at the Centre for Pig Production and Research, Mannuthy, Kerala Agricultural University.

3. The average values for all litter traits were highest in Large White Yorkshire followed by Crossbred and Desi pigs.

4. Least squares analysis of variance for birth weight in three genetic groups indicates that, sex had no significant influence on birth weight in Large White Yorkshire and Desi pigs. Whereas sex had significant effect on birth weight in Crossbred pigs. The sire and

litter size at birth had significant effect on birth weight in all three genetic groups.

5. Least squares analysis of variance for weaning weight in three genetic groups indicate that, the effect of sex had no significant influence on weaning weight in all three genetic groups. The effect of sire and litter size at birth had significant influence on weaning weight in all three genetic groups. But the birth weight and litter size at weaning had significant effect only in Large White Yorkshire and Crossbred pigs but not in Desi pigs.

6. The genetic group was found to have a high significant effect for all litter traits except litter size at birth and weaning.

7. As age advanced the body weights of animals increased with an average of 76.50 ± 3.950kg, 36.875 ± 1.757kg and 66.625 ± 4.013kg in Large White Yorkshire, Desi and Crossbred pigs respectively at 12^{th} fortnight.

8. Highest average daily gain in weight of 0.669 ± 0.025gm (Large White Yorkshire), 0.216 ± 0.017 (Desi) and

0.541 ± 0.027gm (Crossbred pigs) respectively was noticed at fifth month.

9. The genetic group was found to be highly significant for body weight at third, fifth and eighth month of age. But, there was no significant difference between Large White Yorkshire and Crossbred pigs during third month body weight.

10. At fifth month Large White Yorkshire and Crossbred pigs had highest feed conversion efficiency of 2.773 ± 0.104, 3.375 ± 0.256 respectively. But Desi pigs showed highest feed conversion efficiency at fourth month (3.265 ± 0.424).

11. In carcass traits like back fat thickness, loin eye area and dressing percentage, Large White Yorkshire averaged better than Desi and Crossbred pigs. The genetic group was found to be highly significant for all carcass traits.

12. Cost of production per kg live body weight in Large White Yorkshire, Desi and Crossbred pigs from weaning to eight month of age were Rs.47.04, Rs.56.89 and Rs. 49.15 respectively.

13. Large White Yorkshire had higher growth rate, feed conversion efficiency and ADG, carcass traits and litter traits when compared to Crossbred and Desi pigs.

14. Breeding strategy is recommended considering above traits. Large White Yorkshire will be suitable for large scale commercial piggery units whereas Crossbred and Desi pigs will be suitable for small holder system.

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COMPARATIVE EVALUATION OF LITTER TRAITS IN DESI, LARGE WHITE YORKSHIRE AND THEIR CROSSBRED PIGS

By

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ABSTRACT OF A THESIS

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ABSTRACT

The present study was undertaken to compare and evaluate litter traits in Large White Yorkshire, Desi and their Crossbred pigs and to decide a breeding strategy. The data on 20-25 farrowings were collected from Centre for Pig Production and Research, Mannuthy for Large White Yorkshire, Desi and Crossbred pigs. A random sample of eight animals from each genetic group was selected and maintained from weaning to eight month of age to study the growth, feed conversion efficiency and carcass characteristics.

The average birth weight and weaning weight, litter size at birth and weaning, litter weight at birth and weaning, pre-weaning mortality for each genetic group were calculated. Large White Yorkshire was found to be superior for all traits followed by Crossbred and Desi pigs. Crossbred pigs had lowest pre-weaning mortality while Desi pigs had highest litter size at birth. Analysis of variance showed that the effect of genetic group was found to be highly significant for all litter traits except litter size at birth and weaning.

The data were analysed using least squares analysis of variance to study the effect of different factors on birth weight and weaning weight in all three genetic groups. Least squares analysis of variance for birth weight revealed that the effect of sire and litter size at birth was highly significant in all three genetic groups. Sex had significant effect only in crossbreds. For weaning weight, the effect of sire and litter size at birth were found to be highly significant while sex did not show a significant effect on weaning weight in all three genetic groups.

The effect of genetic group was found to be highly significant for third, fifth and eighth month body weight. But there was no significant effect noticed between Large White Yorkshire and Crossbred pigs during third month. The average daily gain and feed conversion efficiency was highest for Large White Yorkshire followed by Crossbred and Desi pigs from weaning to eight months of age.

In carcass traits like back fat thickness, loin eye area, dressing percentage and carcass length, Large White Yorkshire averaged better than Desi and Crossbred pigs. The effect of genetic group was found to be highly significant for all carcass traits. The cost of production per kg of live body weight was calculated in

three genetic groups, Large White Yorkshire had lower cost of production when compared to Crossbred and Desi pigs from weaning to eight month of age.

The present study revealed that Large White Yorkshire had higher body weight gain, better feed conversion efficiency, average daily gain and higher values for carcass and litter traits when compared to Crossbreds and Desi pigs.

Appendix

APPENDIX

Composition of concentrate feed for 100 kg

Feed Ingredients	14 per cent CP	18 per cent CP
Maize	30.0	40.0
Soya bean	7.0	12.0
Wheat bran	32.	20.0
Rice polish	21.4	16.4
Fish (unsalted)	8.0	10.0
Salt	0.6	0.6
Vitamin and Minerals	1.0	1.0
Total	**100.00**	**100.00**