



Comparative performance of Ghungroo and Large Black pig at organized institutional farm conditions

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ABSTRACT

Present study was conducted to compare the production and reproduction performance of Ghungroo and Large Black breeds maintained at ICAR Research Complex for North Eastern Hill Region, Nagaland Centre, Jharnapani, Nagaland. The birth weight (1.09 vs. 0.96 kg), pre-weaning growth rate (174.90 vs. 141.40 g/day) and matured body weight at 7 months (64.74 kg vs. 53.13 kg) were significantly higher ($p < 0.05$) in Large Black gilts as compared to Ghungroo. However, the age at first estrus (209.70 vs. 244.42 days) and conception (237.44 vs. 260.81 days) was significantly lower in Ghungroo than Large Black. The litter size at birth (10.24 vs. 8.38) was significantly higher in Ghungroo than Large Black however, similar pattern in litter size at weaning (7.64 vs. 7.20), litter weight at birth (9.28 vs. 9.96 kg) and weaning (47.35 vs. 52.50 kg) were recorded in Ghungroo and Large Black, respectively. The pre-weaning mortality was higher in Ghungroo (2.64) due to lower birth weight and larger litter compared to the Large Black (1.47, $p < 0.01$). Parity wise comparison of major reproductive traits revealed that litter size at birth and pre-weaning mortality were influenced by breed as well as parity, whereas the individual weight at birth and weaning were only influenced by breed not by parities. Thus, from this study it is concluded that the Ghungroo breed matured early, produce more litter and performs similar to the popular Large Black breed under organized farm condition.

Key words: Ghungroo, Large Black, Parities, Pig, Production, Reproduction.

INTRODUCTION

Pig farming is an integral part of tribal livelihood in North East region of India. Out of total 10.29 million pig population in India, North East region accounts for 38.42 per cent pig. Among the North Eastern states, Nagaland possesses 0.50 million pig population which is about 12.74 per cent of total population in North East. The numbers of pigs available per 1000 household is 181 (Anonymous). Pork is the most preferred meat for majority of tribal population in North East India and there is huge gap in production and demand of pork in the region. Families usually keep an average of 1-2 indigenous or crossbred pigs for fattening with zero to minimum inputs in terms of family labour and feeding. Due to remoteness and inaccessibility, the rural hill farmers of this region has evolved a self sustainable local resource based production system, in which pigs are mainly dependent on local vegetations, crop residues and kitchen waste (Kumaresan *et al.*, 2007, Moanaro *et al.*, 2011).

The distribution of total pig population in Nagaland is mostly located at rural areas (86.05%). Among the rural pig population, 73.02 % are crossbred (Anonymous 2012). Very few organized farms have been established in the region to cater the need of quality pig germplasm. The popular

crossbred piglets are Large Black type, which were imported from Myanmar to the North East through the porous international borders. The Large Black breed of pig, characterized by short and curved snout, undulated drooping ear, long barrel is popular for good growth rate with average litter size of 7 to 10 (Karunakaran *et al.*, 2008). Ghungroo has been recognized recently as breed at its native tract in Duars valley and associated zone of West Bengal state of India (Zaman *et al.*, 2013). This pig is well known for its dark black colour with occasional white patches in short and upwardly curved snout, front and hind leg, typical bull dog type head, long cylindrical barrel, large heart shaped drooping ear and excellent mothering ability with large litter (Sahoo *et al.*, 2012). Although these breeds were popularized in last few years, substantial information on productive and reproductive performances at parities was lacking. Hence, present study was undertaken to appraise the growth and reproductive performances of Large Black and Ghungroo pig at different parities under organized farm condition in Nagaland.

MATERIALS AND METHODS

Study location: The present study was conducted at ICAR Research Complex for North Eastern Hill Region, Nagaland

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Centre, Jharnapani, Medziphema. The centre is located at a latitude of 25°45'24" N, longitude of 93°50'26" E, and altitude of 295m above mean sea level. The annual rainfall varies from 2000 to 2500 mm, with an average humidity of 70 to 80% and temperature ranges between 10 °C to 25 °C.

Animals: The breeding stocks of Large Black and Ghungroo breed were maintained under Mega Seed Project on pig. The parent stock of Ghungroo pigs were procured from National Research Centre on Pig, Rani Guwahati and multiplied through inter-se mating. The breeding records of last four years monitored in designed database were used for present study.

Management: The animals were reared under intensive management practices in concrete housing with adequate spacing. The complete commercial ration was provided to each category of wean, grower and breeder stock. The year round health management was performed for all the stock. The breeding was done mostly through natural service following double mating on 2nd and 3rd day after onset of estrus. The pregnancy was determined based on non-return rate and confirmation by digital palpation at two months post mating. All necessary care and management of piglet at birth, iron supplementation at 4th and 14th day, controlling neonatal diarrhoea and maternal health care were taken into consideration in routine management practices. Weaning was performed at 45 days post farrowing and the sows were bred at first estrus post weaning.

Data recording: The growth performance in terms of body weight at birth, at 15 days interval up to weaning and at monthly interval up to seven months was recorded in Ghungroo (n=13) and Large Black (n=13) gilts. The average daily weight gain (ADG) was calculated for comparison of growth rate. The feed conversion efficiency was measured at post weaning (2 to 3 months) and at grower (3 to 4 months) phase in representative gilts (n=6) of each breed. The reproductive performances, particularly the age at first estrus (AFE) and conception (AFC), litter traits were recorded in these experimental gilts.

The farrowing data of Ghungroo and Large Black sow was retrospectively collected from the herd data base (Table 1) and analysed for litter size at birth (LSB) and litter size at weaning (LSW), litter weight at birth (LWB) and litter weight at weaning (LWW), individual weight at birth (IWB), Individual weight at weaning (IWW), weaning to estrus (WE) interval and inter farrowing (IF) intervals up to sixth parties. The incidence of farrowing was distributed round the year and seasonal influence on reproduction traits was not observed in both the breeds.

Table 1: Parity wise farrowing records of Ghungroo and Large Black sows

Breed	First parity	Second Parity	Third Parity	Fourth Parity	Fifth Parity	Sixth Parity	Total farrowing
Ghungroo	35	29	15	10	9	8	106
Large Black	46	41	35	25	20	14	181

Statistical analysis: Standard statistical model SPSS 16.0 (SPSS INC, USA) was used for analysis of data. Two samples independent 't' test was used for comparison of mean values of different traits in two breeds. The influence of breed and parities and their interaction effects on major reproductive traits were compared using General linear model: Intercept + Breed + Parity + Breed * Parity + Error. The data presented in the text as mean $\pm$ SEM and the mean difference was considered statistically significant at $p < 0.05$ and tendency towards significant difference at $0.05 < p < 0.10$.

RESULTS AND DISCUSSION

Growth performance of gilts: The growth performances in terms of body weight gain at pre-weaning, post weaning grower phase of Ghungroo and Large Black gilts is presented in Fig 1. The average birth weight of piglet, body weight at day 30 and at weaning was significantly higher in Large Black as compared to Ghungroo. The birth weight of piglet is an important trait for survival and postnatal growth and is not related only to the LSB, but several factors such as genotype, follicular development, parity and placental size might have influenced on it (Leenhouwers *et al.*, 1999, Biensen *et al.*, 1999, Egerszegi *et al.*, 2001, Quiniou *et al.*, 2002). Pre-weaning growth characteristics are the best indicator for early selection of pigs. Heavier pigs at birth and weaning have competitive advantage and remain heavier throughout their stay in group (Beaulieu *et al.*, 2010). However, the postnatal growth rate of Ghungroo and Large Black piglet appeared to be similar at first and last fortnight of pre-weaning period whereas, during second fortnight (day 15-30), the average daily weight gain (ADG) was significantly higher in Large Black (201.93 g) than Ghungroo (146.22 g). The results can be explained by the facts according to King *et al.* (1997) and Škorjanc *et al.* (2007), that the Large Black sow

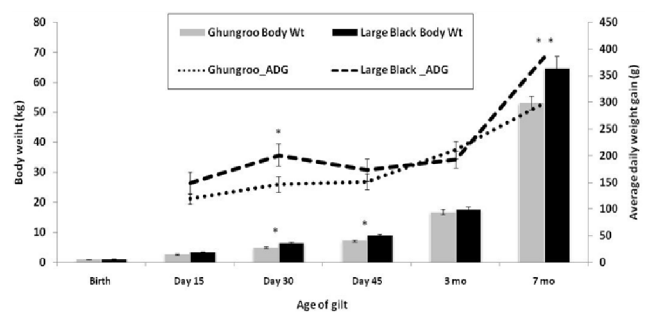


Fig 1: The growth performance (body weight at primary axis and daily body weight gain at secondary axis) of Ghungroo and Large Black gilt under intensive system. Values with asterisk indicate significant difference at $p < 0.05$.

produces sufficient milk after second week and thus, the milk availability per piglets reaches its maximum due to lesser litter size in Large Black (8.38) as compared to Ghungroo (10.24). Although, we have not analyzed the yield and quality of milk from sows in our experiment, but it is assumed that the growth potential of sucking piglet might have been influenced by several other factors such as teat position, composition of milk and amount of milk protein etc. (Noblet and Etienne 1989, Puppe *et al.*, 1993, Škorjanc *et al.*, 2007). After first fortnight, the amount and composition of milk changes that satisfies the energy needs of the piglets and helps in faster growth as observed in our experiment which is also supported by the finding of Boyd *et al.* (1995) and Sahoo *et al.* (2012).

Further, during immediate post weaning period (45 days to 3 months of age), the ADG was increased from 141.40 to 210.50 g in Ghungroo and a meagre 174.90 to 192.70 g in Large Black gilts (Fig. 1). The comparative slower growth at post weaning period in Large Black might be associated with weaning stress whereas, the Ghungroo being an indigenous breed seemed to adapt the transition from milk to solid feeds in much better way. However, at 3 to 7 months of age the ADG was much higher in Large Black compared to Ghungroo (383.92 vs. 297.97 g, $p < 0.05$). The body weight of matured gilt at seven months was recorded as 64.74 kg and 53.13 kg, respectively in Large Black and Ghungroo pig. Similar trend in growth rate of Large Black pig was also observed in earlier reports (Bhatt *et al.*, 2006 and Karunakaran *et al.*, 2008), however for Ghungroo the growth rate was found to be higher in present study than the previous observation of Sahoo *et al.* (2011) and Chaurasia (2013). The feed conversion efficiency (FCE) in Large Black and Ghungroo gilts varied as 3.88 vs. 3.4 at post weaning period (up to 3 months) and 4.13 vs. 4.33 during growing phase (3 to 7 months), which is at par the standard range of commercial crossbreeds (Gondret *et al.*, 2006, Moanaro *et al.*, 2011).

Reproductive performance of gilts: The age at first estrus (AFE) was recorded about a month shorter in Ghungroo (209.7 days) than the Large Black (244.42 days) in present

study (Table 1). The age at first conception (AFC) of Ghungroo pig was 237 days which is within the approved optimal range (220-240 days) for many commercial farms (Koketsu *et al.*, 1999). In general, gilts bred at younger age had smaller litter size in the first and sometimes in the second parity, but had a longer lifetime productivity compared to gilts mated at an older age (Schukken *et al.*, 1994; Koketsu *et al.*, 1999). The AFE and AFC of Ghungroo pig under Nagaland condition was very much similar as of its breeding tract in West Bengal (Pan, 2006). The popular commercial breeds like Hampshire, Large White Yorkshire, and Burmese Black pigs have been observed to be matured at 10-11 months under low input system in North Eastern region (Kumaresan *et al.*, 2007; Karunakaran *et al.*, 2008). In spite of higher body weight of Large Black gilts during the age of sexual maturity, the Ghungroo gilts produced larger litter than the Large Black, however, the LWB, LWW and LSW were found to be similar in both the breeds (Table 2).

Reproductive performance of sow: The reproductive performances in Ghungroo and Large Black pig up to sixth parities were compared in the present study. The effect of parity order has influenced the LSB and pre-weaning mortality whereas, the effect of breeds was significant for LSB, pre-weaning mortality, IWB, and LWW. The interaction effect of both breed and parity was appeared significant only for pre-weaning mortality traits in present study.

Effect of parity: The gestation period was varied 112.38 days at first parity to 116.00 days at sixth parity in Ghungroo whereas; in Large Black no such trend was observed over the parities. Irrespective of breed, the overall LSB increased gradually along the parity and ranged between 7.85 (First parity) to 9.99 at fifth parity and declines thereafter at sixth parity (9.81). The pre-weaning mortality was influenced by parity ($p = 0.022$) and the lowest mortality was recorded at second parity (1.35) and highest at fifth parity (2.56) irrespective of breed. Between breeds, significantly higher mortality was recorded in Ghungroo at third (2.75 vs. 1.30) and fourth (3.78 vs. 1.30) parities as compared to the Large Black ($P < 0.05$, Table 3). The significant higher litter size at

Table 2: Comparative evaluation of major reproductive traits in Ghungroo and Large Black pig

Particulars	Ghungroo	Large Black	P value
Age at first estrus (days)	209.70±6.80	244.42±8.54	0.00
Age at first conception (days)	237.44±8.37	260.81±8.04	0.04
Gestation period (days)	114.01±0.69	114.78±0.22	0.23
Average litter size at birth	10.24±0.35	8.38±0.23	0.00
Litter weight at birth (kg)	9.28±0.58	9.96±0.41	0.35
Litter size at weaning	7.64±0.30	7.20±0.22	0.24
Individual litter weight at birth (kg)	0.905±0.04	1.156±0.03	0.00
Litter weight at weaning (kg)	47.35±3.47	52.50±3.01	0.27
Avg. individual litter weight at weaning (kg)	7.13±0.36	8.42±0.30	0.01
Pre-weaning mortality per litter	2.64 ± 0.22	1.47 ± 0.15	0.00
Weaning to estrus interval (days)	13.82±1.42	15.59±1.12	0.33
Inter-farrowing interval (days)	178.28±2.84	181.17±1.89	0.40

Table 3: Parity wise comparison of pre-weaning mortality in different breed of Pig

Litter size	Ghungroo	Large Black	P value
First parity	1.83±0.32	1.40±0.28	0.349
Second parity	1.31±0.35	1.40±0.31	0.831
Third parity	2.75±0.48	1.30±0.35	0.040
Fourth parity	3.78±0.64	1.30±0.40	0.028
Fifth parity	3.29±0.72	1.83±0.45	0.139
Sixth parity	2.89±0.64	1.60±0.38	0.119

Values with different superscript in a row indicate significant difference at $p < 0.05$

3rd and 4th parities in Ghungroo was directly linked to the higher rate of mortality at these parities.

Similar trend of LSB in Ghungroo has been reported by Pan (2006), Sahoo *et al.* (2012) and Zaman *et al.* (2013). The higher litter size and lower birth weight in Ghungroo lead to more pre-weaning mortality (2.64 vs. 1.47 per litter, $p < 0.01$) than those of Large Black. The increasing litter size along with the advancement of parities in Ghungroo leads to insufficient milk availability for each piglet and resulted in reduced survivability. Piglet survival is an outcome of complex interactions between the sow, the piglet and the environment. The body condition score of sow at farrowing, mothering ability, and sucking behaviour of piglets have a marked effect on survival of new born and therefore commercial strategy has now been focused on improving the farrowing environment to modify sow behaviour and increase human intervention (Edwards, 2002). Besides, environmental effect, the higher pre-weaning mortality is might be due to the results of genetic effects as reflected by increase litter size and reduced litter weight in relation to dam body weight in indigenous pig compared to commercial breeds. Basumatary *et al.* (2009) also found higher pre-weaning mortality in indigenous pig (14.26 %) than the upgraded Khasi local X Hampshire (9.58%).

Effect of breed: In Ghungroo, the LSB ranged from 8.51 to 11.33 whereas, it was varied between 7.18 to 9.24 in Large

Black. Between breeds, the LSB was significantly higher at first (8.51 vs. 7.18), third (10.94 vs. 8.26), and sixth (11.33 vs. 8.28) parities in Ghungroo ($P < 0.05$) than Large Black (Fig. 2). However, no detail study reported earlier the effect of breed on litter size in Ghungroo and Large Black pig at different parities at its breeding tract or in any organized farm located in the North East region. In spite of higher LSB, the higher pre-weaning mortality in Ghungroo in present study has resulted in similar litter size for both the breed at weaning and no significant effect was observed on parities. The LSW ranged between 6.66 to 8.81 in Ghungroo and 6.70 to 8.0 in Large Black over the parities (Fig. 2).

In contrary to LSB, the LWB was similar irrespective of breed and parities, and the average weight was recorded between 7.72 kg to 10.96 kg in Ghungroo and 8.67 kg to 11.92 kg in Large Black (Fig. 3). The IWB was significantly influenced by breed ($p < 0.01$) but not by the parities. In Ghungroo, the IWB ranged between 0.82 to 0.97 kg, whereas, it varied from 1.06 to 1.25 kg in Large Black. The IWB of Ghungroo recorded in present study was similar to the previous reports of Sahoo *et al.* (2012), Banik *et al.* (2013). Likewise, the IWW was appeared to be influenced by breed ($p < 0.01$) and varied from 6.65 to 8.04 kg in Ghungroo and 6.97 to 9.73 kg in Large Black (Fig. 4). The weaning weight of individual piglet was seemed to be correlated to birth weight and was higher in Large Black than the indigenous breed like Teny-vo, Niang Megha and Khasi local and similar to other commercial breed viz., Hampshire, Large White Yorkshire and crossbreed pig (Kumaresan *et al.*, 2006, Karunakaran *et al.*, 2008, Sahoo *et al.*, 2012, Banik *et al.*, 2013). Moreover, between breeds, the IWW was differed significantly at first (6.75 vs. 9.74 kg, $p < 0.01$) and second (6.77 vs. 8.68 kg, $p < 0.05$) parities.

In contrary, parity wise comparison of LWW was neither influenced by breed ($p = 0.27$) nor by parity ($p = 0.34$) except at the sixth parity (51.52 vs. 36.08 kg, $p < 0.05$) and it ranged between 43.80 to 57.10 kg irrespective of breed over

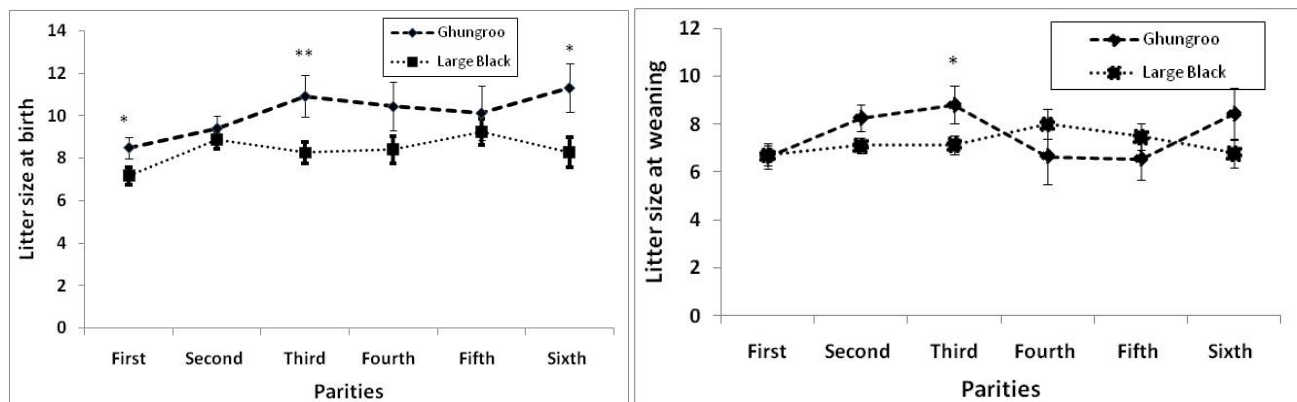


Fig 2: Litter size at birth and weaning in Ghungroo and Large Black pig at different parities. * indicates $p < 0.05$ and ** indicates $p < 0.01$.

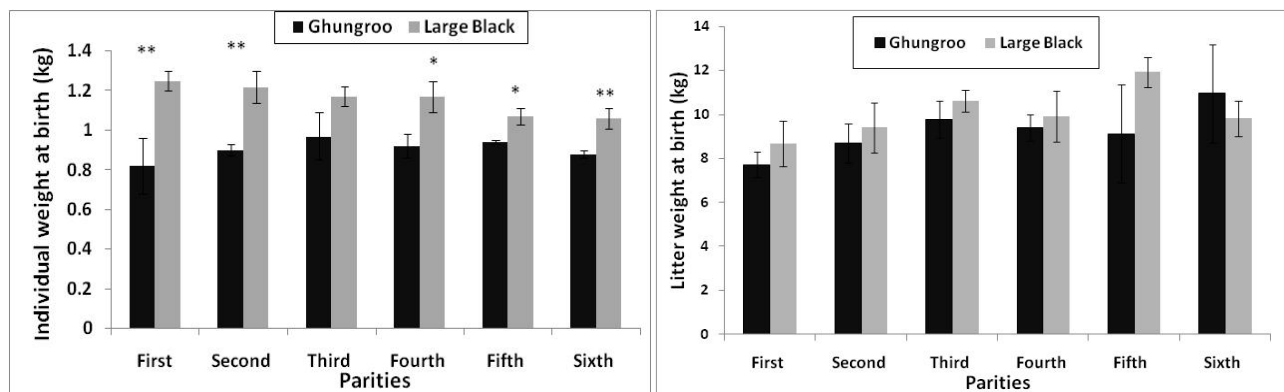


Fig 3: Individual and litter weight at birth in Ghungroo and Large Black at different parities. * indicates $p < 0.05$ and ** indicates $p < 0.01$.

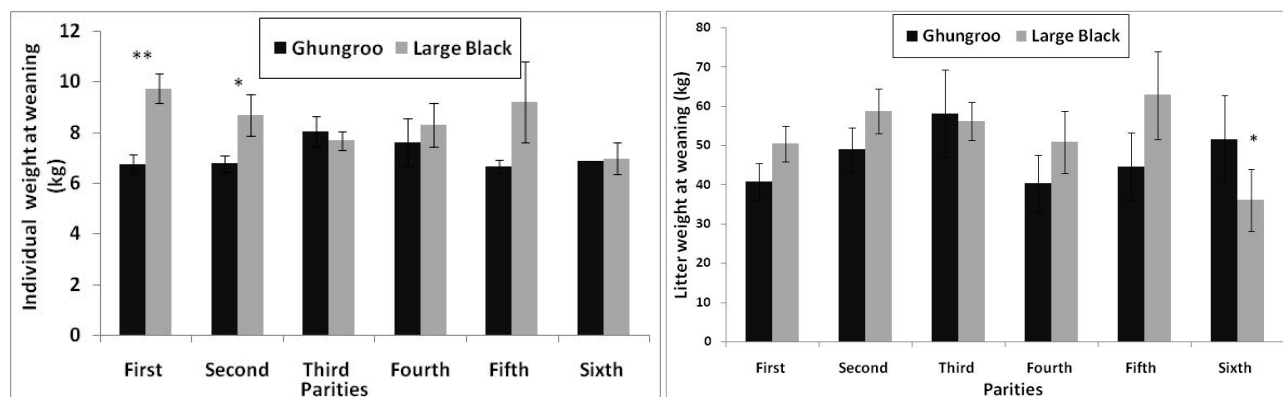


Fig 4: Individual and litter weight at weaning in Ghungroo and Large Black pig at different parities. * indicates $p < 0.05$ and ** indicates $p < 0.01$.

the parities. At sixth parity reduced litter size and lower growth rate leads to decline LWV in Large Black as compared to Ghungroo. Sahoo *et al.* (2012) also observed wide variability (30-58 kg) in LWV of Ghungroo due to difference in litter size over the parities. In exotic pig the LWV was reported to be higher than the indigenous and crossbred (Kumaresan *et al.*, 2006).

Further, the litter size and lactation performance had no influence on subsequent reproduction in both the breed throughout the production life. After weaning, the sows normally returns to estrus and the difference between weaning and following estrus was neither influenced by breeds ($p=0.33$) nor by the parities ($p=0.94$) in Ghungroo and Large Black up to the sixth parities. The WE interval was recorded at the range of 11.77 to 16.33 days and 14.14 to 18.18 days in Ghungroo and Large Black, respectively. Similarly, in Ghungroo and Large Black, the IF interval was varied between 164.64 to 185.40 days and 174.55 to 182.36 days respectively, which was within the range as previously reported by Sahoo *et al.* (2012), but comparatively lower

than the exotic and crossbred pig in Mizoram (Kumaresan *et al.*, 2006).

From this study it is concluded that Large Black pig performs better in terms of pre-weaning and post weaning growth performance and attains higher body weight at 7 months of age as compared to Ghungroo. However, Ghungroo pig is proved to be excellent for its early maturity, higher litter size, lifetime production of piglets up to sixth parities. In spite of comparatively lower birth weight, the lifetime performance in Ghungroo is at par the popular Large Black Pig under Nagaland condition. Hence, the Ghungroo breed could be promoted further for breeding purpose under low input production system in Nagaland and neighbouring North Eastern state in India.

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REFERENCES

- Anonymous (2012). Livestock census 2012, Dept. of Animal Husbandry, Dairying and Fisheries, Govt. of India.
 Banik, S., Naskar, S., Pankaj, P. K., Pourouchottamane, R., Barman, K., Sahoo, N. R. and Tamuli, M. K. (2013). Construction of growth band for early selection of indigenous pigs in India. *Appl. Biol. Res.* 15: 73-77.

- Basumatary, R., Naskar, S., Kumaresan, A., Khargharia, G., Kadirvel, G. and Bardoloi, R.K. (2009). Analysis of mortality pattern among indigenous and upgraded pigs under subtropical hill agro climatic conditions in Eastern Himalaya. *Livestock Sci.* **123**: 169-174.
- Beaulieu, A.D., Aalhus, J.L., Williams, N.H. and Patience, J.H. (2010). Impact of piglet birth weight, birth order, and litter size on subsequent growth performance, carcass quality, muscle composition, and eating quality of pork. *J. Anim. Sci.* **88**: 2767-2778.
- Bhatt, B.P., Bujarbaruah, K.M. and Sharma, Y.P. (2006). Integrated farming system: a sustainable alternative for the benefit of small scale farmers and the environment. In: agroforestry in North East India: opportunities and challenges. [B.P. Bhatt and K.M. Bujarbaruah. (Eds.)] ICAR Research Complex for NEH Region, Umiam, Meghalaya, India. PP: 537-555.
- Biensen, N.J., Haussmann, M.F., Lay, D.C., Christian, L.L., Ford, S.P. (1999). The relationship between placental and piglet birth weights and growth traits. *Anim. Sci.* **68**: 709-715.
- Boyd, D.R., Kensinger, R.S., Harrell, R., Bauman, D.E. (1995). Nutrient uptake and endocrine regulation of milk synthesis by mammary tissue of lactating sows. *J. Anim. Sci.* **73**: 36-56.
- Chaurasia, R.K. (2013). Effect of Minamil on the growth performance and age at maturity of Ghungroo pigs in field condition in Zunheboto district. *Ind. J. Hill Farming* **26**: 116-117.
- Edwards, S.A. (2002). Perinatal mortality in pig: environmental or physiological solution? *Livestock Prod. Sci.* **78**: 3-12.
- Egerszegi, I., Torner, H., Ratky, J., Brüssow, K.P. (2001). Follicular development and preovulatory oocyte maturation in Hungarian Mangalica and Landrace gilts. *Arch. Tierz., Dummerstorf* **44**: 413-419.
- Gondret, F., Lefaucheur, L., Juin, H., Louveau, I., Lebre, B. (2006). Low birth weight is associated with enlarged muscle fiber area and impaired meat tenderness of the longissimus muscle in pigs. *J. Anim. Sci.* **84**: 93-103.
- Karunakaran, M., Kumaresan, A., Bhatt, B.P., Bujarbaruah, K.M., Bordoloi, R.K., Das, A. and Ngachan, S.V. (2008). Small holder pig production system in Nagaland. Technical Bulletin, ICAR Research Complex for NEH Region, Umiam, Meghalaya.
- King, R.H., Mullan, B.P., Dunshea, F.R., Dove, H. (1997). The influence of piglet body weight on milk production of sows. *Livestock Prod. Sci.* **47**: 169-174.
- Koketsu, Y., Takahashi, H., Akachi, K. (1999). Longevity, lifetime pig production and productivity, and age at first conception in a cohort of gilts observed over 6 years on commercial farms. *J. Vet. Med. Sci.* **61**: 1001-1005.
- Kumaresan, A., Pathak, K.A., Bujarbaruah, K.M. and Das, A. (2006). Swine production in Mizoram. Technical Bulletin, ICAR Research Complex for NEH Region, Mizoram Centre, Kolasib, Mizoram.
- Kumaresan, A., Bujarbaruah, K.M., Pathak, K.A., Chetri, B., Das, S.K., Das, A. and Ahmed, S.K. (2007). Performance of pigs reared under traditional tribal low input production system and chemical composition of non-conventional tropical plants used as pig feed. *Livestock Sci.* **107**: 294-298.
- Leenhouders, J.I., Van der Lende, T., Knol, E.F. (1999). Analysis of stillbirth in different lines of pig. *Livestock Prod. Sci.* **57**: 243-253.
- Moanaro, Ngullie, E., Walling, I., Krose, M. and Bhatt, B.P. (2011). Traditional animal husbandry practices in tribal states of Eastern Himalaya, India: a case study. *Indian J. Anim. Nutri.* **28**: 23-28.
- Noblet, J. and Etienne, M. (1989). Estimation of sow milk nutrient output. *J. Anim. Sci.* **67**: 3352-3359.
- Pan, S. (2006). Planning for Livestock Production with special reference to West Bengal context. Proceedings of Planning for Livestock Production with Special Emphasis on Indigenous Animal. *Gene. Res.* pp: 13-22.
- Puppe, B., Tuchscherer, M., Hoy, St., Tuchscherer, A. (1993). Soziale Organisationsstrukturen beim intensiv gehaltenen Schwein. I. Mitt.: Ethologische Untersuchung zur Saugordnung. *Arch. Tierz., Dummerstorf* **36**: 539-550.
- Quiniou, N., Dagorn, J., Gaudré, D. (2002). Variation of piglets' birth weight and consequences on subsequent performance. *Livestock Prod. Sci.* **78**: 63-70.
- Sahoo, N.R., Rajkhowa, S., Choudhary, K.B.D., Das, A., Pankaj, P.K., Maini, S. and Ravikanth, K. (2011). Efficacy of poly herbal liver tonic products in promoting growth performances in post weaned Ghungroo piglets. *Res. Opin. Anim. Vet. Sci.* **1**: 284-287.
- Sahoo, N.R., Das, A., Naskar, S., Banik, S., Pan, S. and Tamuli, M. K. (2012). Ghungroo pig: a new promise in Indian piggyery. Technical Bulletin, National Research Centre on Pig, Rani, Guwahati.
- Schukken, Y.H., Buurman, J., Huirne, R.B.M., Willemse, A.H., Vernooij, J.C.M., van den Broek, J., Verheijden, J.H.M. (1994). Evaluation of optimal age at first conception in gilts from data collected in commercial swine herds. *J. Anim. Sci.* **72**: 1387-1392.
- Škorjanc, D., Brus, M. and Potokar, M.C. (2007). Effect of birth weight and sex on pre-weaning growth rate of piglets. *Archives Tierz. Dummerstorf* **50**: 476-486.
- Zaman, G., Chandra Shekhar, M., Ferdoci, A. M. and Laskar, S. (2013). Molecular characterization of Ghungroo pig. *Int. J. Anim. Biotech.* **3**: 1-4.