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Influence of age, body weight and parity on reproductive characteristics in pig (*Sus scrofa domesticus)*

[*1]Tchoffo H, [2]Matafeu AMN, [3]Ngoumtsop HV, [1]Deutcheu SN, [1]Dongmo ABN, [1]Lontio FA, [1]Azafack DK, [1]Motchewo ND, [1]Ngoula F and [2]Kana JR

[1] Animal Physiology and Health Research Unit, Faculty of Agronomy and Agricultural Sciences, University of Dschang, Cameroon.

[2]Animal Nutrition and Production Research Unit, Faculty of Agronomy and Agricultural Sciences, University of Dschang, Cameroon.

[3]Higher Institute of Halieutiques Sciences (ISH), Yabassi, Cameroon

Corresponding author: tchoffo.herv@yahoo.fr

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ABSTRACT

Aim: The study was aimed to evaluate the effects of ages, body weights and parity on reproductive characteristics in pigs.
Method and Materials: Primary data collected during the training period on 29 sows and 06 boars and the secondary data from the farm management were used.
Results: Sow's reproductive characteristics values change with age, body weight and parity number. Independent of the these variation factors, age of sows at 1st mating was 7.32 ± 0.85 months, corresponding to an average weight of 77.08 ± 22.82 kg. The gestation length was 114.26 ± 1.09 days. The average litter sizes at birth and weaning were 9.09 ± 3.11 and 8.52 ± 3.46 piglets respectively. The average weight of piglets at birth was 0.95 ± 0.15 kg and the heaviest piglets were obtained with small litter sizes. Weaning occurred at 6.57 ± 0.97 weeks with an average body weight of 7.01 ± 1.42 kg. The average length from weaning estrus was 17.52 ± 5.42 days. The pig body weight at mating was positively correlated with the age at mating (ρ = +0.77). The piglet number at birth was negatively correlated with the gestation length (ρ = -0.52). Litter size at birth was positively correlated with sow weight (ρ = +0.82), sow age (ρ = +0.66), and parity number (ρ = +0.39) but negatively correlated with gestation length (ρ = -0.67). There was a positive correlation between the weight of piglets at weaning and weaning length (ρ= +0.72).
Conclusion: It was concluded that all values of reproductive characteristics considered were compared to those recorded by previous authors. The study of various factors revealed that age, body weight and parity influence reproductive characteristics values.

Keywords: Pig, reproductive performance, gestation, parity, parturition, weaning.

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Introduction

In poor or developing countries, efforts in the livestock and agriculture sectors are still deficient to satisfy population needs in food (FAO, 2000). Poor nutrition characterized by diets deficient in proteins of both quantitative and qualitative still affects 11% of the world's population. This deficit is an effect of rapid growing demographics that lead to the decrease in individual food intake. According to FAO (2016), global meat intake was 323 million tonnes in 2017 compared to 67 million tonnes in 1957. This consumption is expected to reach 470 million in 2050. As a solution, a particular attention should be placed on the production of animals with higher growth and reproductive performances such as pigs.

Pig is a mammal characterized by puberty age located between 3-6 months for the females and 4 months for the male. The sow's sexual cycle lasts about 21 days in the absence of gestation and 20 to 22 weeks if gestation (16 weeks), lactation (3 to 5 weeks) and weaning-estrus interval (1 week) (Martel, 2008) are taken in consideration. The average fertilization rate observed in breeding is 85-90%. In the case of fertilization, gestation lasts about 114 days (3 months, 3 weeks, 3 days) (IFIP, 2008). Sows give birth to about 14 piglets with an average weight of 18 kg (Quiniou *et al*., 2012). The

age at first calving is between 12.38 and 19.42 months for 1.5 to 2.24calvingnumber per year. Under natural conditions, lactation lasts 10 to 12 weeks, but it is reduced between 3 and 5 weeks under breeding conditions (Orgeur*et al*., 2002). The sow weans 80-85% of its piglets at 26 to 28 days old weighing between 7.28 -16.3 kg (IFIP, 2008). Under breeding conditions, the estrus behavior occurs on average 4 days after the weaning (Martel, 2008).

However, the above-mentioned reproductive characteristics are not only influenced by exogenous constraints (nutrition, breeding system, climatic conditions, diseases, etc.) but also by the animal itself (breed, sex, age and weight of the animal, individual, physiological condition...). The objective of this work is to improve knowledge on the effects of age, body mass and parity on pig reproductive characteristics in order to streamline their management and exploitation.

Materials and Methods

Study area

The present study was designed from October 2019 to March 2020 in Nsimalen Agricultural Farm (Yaounde Cameroon). The farm is about 20 km from Yaounde with latitude 3-44' 06 ''north and Longitude 11'32' 48'' East. The altitude is 751m andthe Monthly temperatures ranges from 23°C to 27°C.

Breeds of pig reared in Nsimalen Agricultural Farm

The pigs breeding in the farm are Naïmahybrids (picture 1). Naïma sow has high prolificacy and exceptional mothering qualities includingrapid calving with maximum number of viable piglets,very important mild production, easy and rapid farrows. Terminal sir has excellent performances combined with outstanding carcass and meat quality.

Fig 1: Naima hybrid

Housing

The Nsimalen farm contains two buildings: one for fattening with 10 lodges and the other for breeding divided into several sectors:

- The maternity sector: it contains 10 lodges with the measures of 2.70 m long; 1.70 m wide and 1.30 m high for each. Inside each lodge,there are a feeder (1m long; 0.3m high and 0.60m wide) and drinker (0.80m in length; 0.5m high and 0.40m wide).
- The pregnant sow sector: it is built on the same model as the maternity sector.
- The area for sows in lactation or breeding boars: It has 06 lodges and each lodge containsa feeder and a drinker.

Food

There were two types of diet on the farm: piglet and adult food as summarized in table 1. 5 kg of adult food were given to a sow at lactation stage, 2 kg to an empty or gravid sow and a sir. The quantity served to piglets was adjusted gradually with their age.

Table 1: Composition of the diet in Nsimalen Agricultural Farm

	Amount (kg/100kg)	
Constituents	**Piglet diet**	**Adult diet**
Corn	53.05	20.53
Branwheat	7.07	22.54
Branrice	/	16.10
Palm Kernelmeal	7.07	25.76
Peanut cake	8.84	4.02
Soybeanmeal	8.84	4.02
Pemix 3%	/	2.41
Premix 1%	10.61	/
Oeistershell	2.65	3.22
Salt	0.53	0.72
Dicalcium Phosphate	0.88	0.40
ferricSulphate	0.35	0.16
Antitoxin	0.08	0,.08
Total	100	100

Biosecurity Measures in Nsimalen Agricultural Farm

The Nsimalen farm is bounded by a fence. The entrance of each building has a pediluverenewed regularly. Visits are strictly regulated. In case of a visit by a stranger, he disinfects his hands and whole bodybefore the breeding building.

Care for piglets

Piglets are born in a place protected by banana leaves that allowed them to warm up and clean themselves. Three days after the calving, the piglets received 2 ml of iron. In the case of neonatal diarrhea, theypigletsare treated onoxytetracycline.

At weaning, the piglets are dewormed and also received a vitamin C.

Care for reproductive pig

Reproductive pigs are selected taking into account their conformation and the number of nipples (the selected animals have more than 12 nipples). These selected animals are mated only when they weigh 45 kg or more. Apart from observing the clinical signs of heat, heat detection is done using boar. At mating, the sow in heat is brought into the boar's box for one to two days. The gestation test is done by the heat return control. If the sows still show signs of heat, they are again mated. The pregnant sows are shifted to dry, lighted and well ventilated farrowing pen 4-5 days before calving to avoid disturbances. As soon as the piglets are born, they are removed from a nervous sow and they help them to milk.

Collectingof the data on the studied parameters

The data on reproductive characteristics of 29 sows and 06boarsNaïma, selected based on the availability of information were recorded. The reproductive characteristicsstudied were as follow:

Age at 1st mating: the total age at mating divided by the number of sow mated;

Weight at 1st mating: total weight of sow at mating day/ number of sowweighted;

Gestation length: It was defined by the number of days between the date of success mating and the date of delivery;

Parity: it is defined as a number of litters a sow has carried (included current pregnancy);

Size of the litter: it is recorded at delivery as a total number of piglets born per farrowing by a considered sow;

Weight of piglets at birth: sum of piglet weights from one litter/number of piglets. The piglets were weighedusing a scale of 25 kg of capacity and 100g precision;

Stillbirth rate = (Number of deaths born/Total born number) x 100;

Mortality rateat weaning = (Number of deathspiglets before weaning/ numbers of live born)x 100;

Lactation length (average days): it was defined as a sum of lactation days in a given period/ number of sow weaned;

Age of piglets at weaning: it was recorded at weaning as a number of days from farrowing to weaning (day of farrowing= day 0);

Weight of piglets at weaning = weight of all piglets (kg), that were weaned from one litter/number of piglets weighted;

Pre-weaning mortality: number of piglets born alive per litter that die before weaning;

Weaning- estrus interval: the interval between the date of weaning and the date of next estrus.

Statistical analysis

The statistical analysis of the data was performed using SPSS 20.0 software. Data on sow weight and age at mating, gestation length, litter size, mortality rates, piglet age and weight at weaning, weight at birth and weaning were subjected to descriptive statistics. One-way ANOVA followed by Duncan post hoc test were performed to test the effects of weight at mating and age on different reproductive characteristics under studied. The effect of parity on studied characteristics was performed using student t- test. A p value of less than 0.05 was considered as significant. The relationships between reproductive characteristics were highlighted by the correlation coefficient of Bravais Pearson.

Results and Discussion

Naïma reproductive characteristics in Nsimalen Agricultural Farm

The reproductive characteristics of Naïma sows in Nsimalen agricultural farm were shown (Table 2). The results showed that the average age of sow at 1st mating was 7.32 ± 0.85 months, which corresponded to an average weight of 77.08 ± 22.82 kg. The age at mating in this study was slightly lower than the 7.75 ± 0.64 and 7.97 ± 1.05 months obtained respectively by Fomekong (2007) and Ngombé (2000) in the Department of Bamboutos, West region of Cameroon. This age was widely below the 8.20±0.56 months obtained by Nguedia (2016) at the western integrated breeding farm and the 11 months obtained by Nkoum (1990) in the Fongo-tongo farm. However, theage at mating was within the 3-10 months interval mentioned by Holnes (1997). The difference in age at mating would result from factors such as quantity and quality of food and water, frequency of distribution, climate conditions, pig housing management and experience of the farmers.

The average litter sizes at birth and weaning were 9.09 ± 3.11 and 8.52 ± 3.46 piglets, respectively. These values were consistent with 9± 12 piglets at birth and 8±10 at weaning reported by PACA (2013). The lactation length in Nsimalen agricultural farm was 6.57 ± 0.97 weeks, this value

was in accordance with the 33±42 days reported by PACA (2013). The weaning-estrus interval was 17.52 ±5.42 days. The results were greater than the 3 to 8 days reported by Bastianelli *et al*. (2002). The increase in weaning-estrus interval observed in this investigation could be explained by the fact that some sows at weaning were affected by thin sow syndrome which enlarged the return of estrus.

At the Farrowing, the average number of piglets was 4.74±2.06 for males and 4.35±1.44 for females. At weaning, these values were 4.27±1.86 and 4.26 ± 1.47 respectively for males and females. The number of male piglets at birth was slightly higher than that of females. At weaning, there was virtually no difference. This would be justified by the low weight recorded in some males at birth. This poor weight would make them vulnerable to environmental factors and therefore resulted in their death before weaning.

Table 2: Reproductive Performances in Nsimalen agricultural farm

Performances de reproduction	Mean ± Standard deviation
Age of sow at 1st mating(month)	7.32 ± 0.85
Weight at 1st mating(kg)	77.08 ± 22.82
Gestationlength (day)	114.26 ± 1.09
Size of litters at farrowing	9.09 ± 3.11
Size of litters at weaning	8.52 ± 3.46
Lactation length (week)	6.57 ± 0.97
weaning-estrus interval (day)	17.52 ± 5.42
Number of female at farrowing	4.35 ± 1.44
Number of male at farrowing	4.74± 2.06
Number of female at weaning	4.26 ± 1.47
Number of male at weaning	4.27 ± 1.86

Distribution of farrowing based on the gestation length inNsimalen agricultural farm

The distribution of birth based on the gestation length (Fig. 2). It showed that 69% of Farrowing are between 114 and 115 days of gestation with an average length of 114.26 ± 1.09 days. These results were similar to those obtained by Fomekong (2007) at the Kounden breeding station with an average gestation period of 113.12 days and by Nguedia (2016) at the Western Integrated Livestock Farm with an average gestation period of 114.65 days. The present result was higher than the average of 111.4 days recorded by Fozen (1999) in The Menoua department. The average gestation length noted in the Nsimalen farm remains close to 114 days mentioned by Bastianelli *et al*. (2002) in Naima hybrid. The highest gestation length in this investigation was 117 days. This high value could be explained by poor note-taking by the workers which recorded wrong fertilization day. It could also be attributed to the misdiagnosis of success gestation.

Distribution of farrowing rate based on the litter sizes in Nsimalen agricultural farm

As a result, the litter size at birth in Nsimalen farm ranged from 2 to 16 piglets. The high percentage of farrowing (60.46%) is for 7-11 piglets. The average litter size at farrowing was 9.09 ± 3.11 piglets per litter. The average litter size noted in this study was close to the 9.70±3.16 piglets recorded in the same breed by Fomekong (2007) at the Kounden Station and 9.22 ±1.90 piglets obtained by Lontsi (2001). However, it was higher than 7.43 ± 2.82; 6.89 ± 2.14; 7.9 ± 2.5 and 8.27 ± 1.49 piglets respectively obtained by Ngangué (1996) in northern Cameroon, Fozen (1999) in the department of Ménoua, Ymelé (2004) in Dschang town and Noubissi (2006) in DschangPenka-Michel. The differences in these observations would result from endogenous factors (age, body weight, paritynumber, male used for mating) and exogenous constraints (fluctuation of climate characteristic values, farm management, quality and quantity of food and water).

Birth and weaning mortality rate in Nsimalen Agricultural Farm

The calving and weaning mortality rate in Nsimalen Agricultural Farm was observed (Fig. 4) and the average stillbirth rate was 1.70%. This rate was lower than those obtained by Ngombe (2000) in the department of Bamboutos- Cameroon (3.18% and 4.10% respectively for improved and local breeds). It was close to 1.85% mentioned by Ngangué (1996) in the north region of Cameroon. This low mortality rate recorded in the present study was linked to the rigorous care of employees in the farm. The assistant of animals by farmers at different stages of reproduction would be more interesting to boost their reproductive performances. The weaning mortality rate was 9.07%. This rate was very low compared to the 14.59% and 21.46% obtained respectively by Ngombé (2000) in the department of

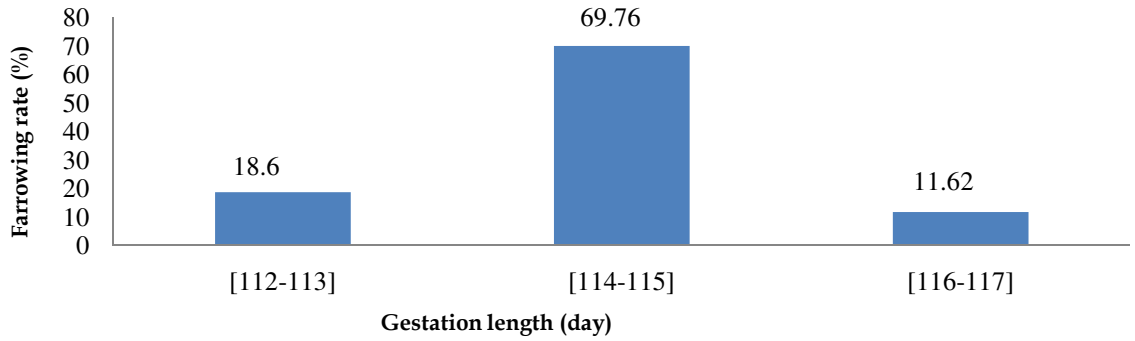

Fig.2: Distribution of calving rate based on Gestation length

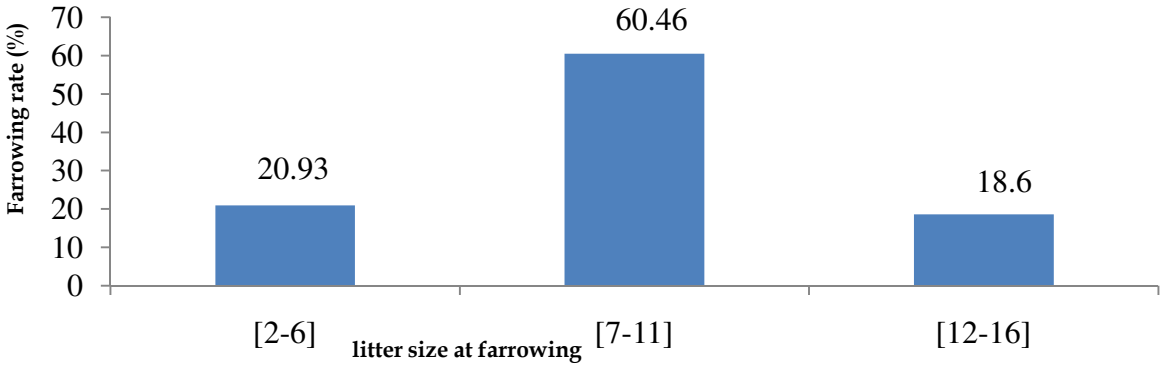

Fig. 3 : Distribution of calving rate based of the litter size

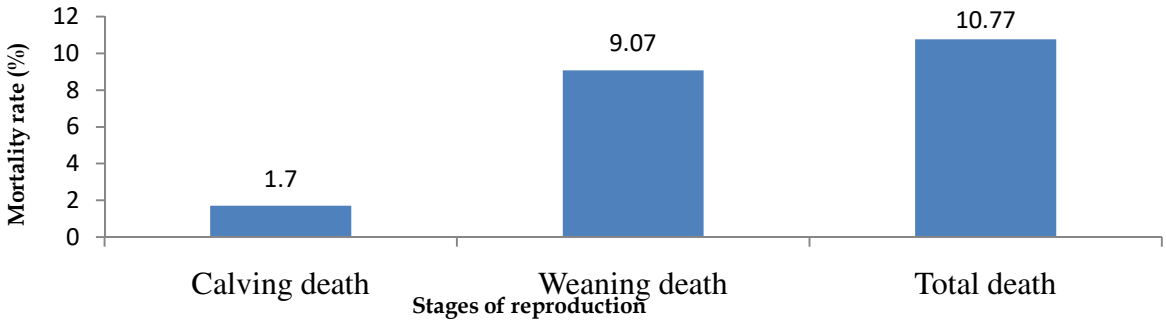

Fig. 4: Birth and weaning mortality rate in Nsimalen Agricultural Farm

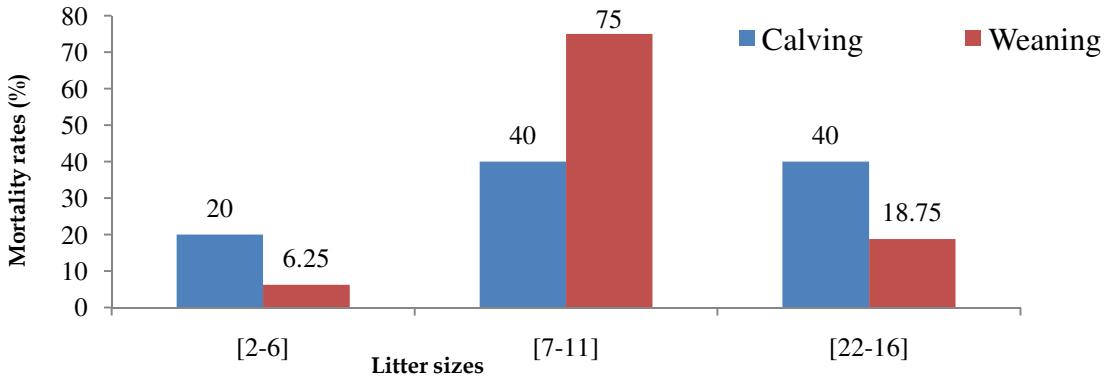

Fig. 5: Farrowing and weaning mortality rates based on litter size in pig

Bamboutosand Noubissi (2006) in Fokoue-Dschang. The animal weaning mortality rate would be a results of diverse factors included the weight of animal at birth, hygiene conditions in lactating stage, quality and quantity of food and water, experience of the farmers, climate conditions, building of sow at lactation stage and the ability of sow to milk and take of their offspring.

Farrowing and weaning mortality rates based on litter size in pig

The farrowing and weaning mortality rates based on litter size in pig (Fig. 5). In the interval of [2-6] piglets, the farrowing and weaning mortality rates were 20 and 6.25% respectively. In the range of [7-11] piglets, mortality rates at farrowing and weaning were 40% and 75% respectively. The low mortality rate in the interval [2-6] will be justified by the fact that sows with small litter sizes had more time to take care for their piglets. This effect subsequently reduced the mortality at lactation stage and increases the viability at weaning. Also, the small litter sizes would positively correlate to high weight that helps the piglets to be more active and resist to environment constraints. The farrowing and weaning mortality rates in 12 to 16 piglets were 40% and 18.75%, respectively. The decrease in the weaning mortality rate is due to the fact that the farmers accord more attention to sows with large litter sizes.

Effects of parity on Reproductive characteristics in pig

The gestational length decreased significantly ($p<0.05$) with parity (Table 3). These results were consistent with those obtained by Fomekong (2007) in the same breed of pig. The decrease in gestation length with the parity number would due to the fact that the genital tract was depleted with successive birth and therefore release the uterine content earlier. The litter size at birth increased significantly ($p<0.05$) with increase in parity. These results were in accordance with the work of Nguedia (2016) at the Western Integrated Livestock Farm in Cameroon. The increase in litter size would result from the increase in ovulation rates with age mentioned by Eusebio (1980) and Kirk (1986). The birth litter size was positively and significantly correlated to the parity number (ρ= +0.39;$p<0.05$). This result suggests that these reproductive characteristics move in the same direction. The increase in the weaning litter size would be logical consequences of the high live born recorded. Indeed a positive and non-significant correlation (ρ= +0.9; $p>0.05$) was recorded between the weaning litter size and the birthlitter size. The party had no significant effect on lactation length, weaning-estrus interval, and weaning and birth mortality rates. However, the number of males and females at birth and weaning increased in pigs at 2 calving number in reference toprimiparous. This result would be justified by the growth, the development and function of genital organs with increase with age and parity. The uterine space would increase as the parity increase. This effect would subsequence allow the implantation and growth of the large number of embryos until the delivery.

Table 3: Effects of parityon reproductive characteristics in pig

Reproductive characteristics	Number of calving		p-value
	1 (n=13)	2 (n=10)	
Gestation length(Day)	114.78 ± 0.95[a]	113.65 ± 0.93[b]	0.00
birth litter size	8.00 ± 3.07[b]	10.35 ± 2.45[a]	0.01
Weaning litter size	6.96 ± 3.49[b]	9.90 ± 2.36[a]	0.00
Lactation length(Day)	6.50 ± 1.01	6.65 ± 0.93	0.62
Weaning -estrusinterval (Day)	16.00 ± 3.18	18.78± 6.57	0.14
Number of male at birth	3.90 ± 1.07[b]	5.10 ± 1.05[a]	0.03
Number of female at birth	4.55 ± 1.96	5.25 ± 1.88	0.26
Number of male at weaning	3.75 ± 1.37[b]	5.05 ± 0,99[a]	0.00
Number of female at weaning	4.05 ± 1.98	4.85 ± 1.75	0.18
Stillborn piglets	0.09 ± 0.28	0.05 ± 0.22	0.64
Pre-weaning mortality	03.52 ± 0.84	0.40 ± 0.68	0.61
Total deathnumber	0.56 ± 084	0.47 ± 0.69	0.71

[a, b] On the same line, means with the different letter were significantly different ($p< 0,05$). *n* =number of sow

Effects of weight of sow at mating on reproductive characteristics in pig

The effects of sow weight on reproductive performance and mortality rates in pig (Table 4). As a result, the gestational and lactation length, the weaning- mating length and the total average number of deaths were not significantly affected by the weight of sows. On the other hand, the birth and weaning litter sizes increased significantly ($p<0.05$) the weight of sows increases. These results were consistent with observations of Hochereau *et al*. (1997) who stated that weight has a very significant influence on the rate of ovulation and the prolificacy of sows. The numbers of piglets (males and females) obtained at birth and weaning

between [45-65] and [65-85] were comparable p>0.05), but significantly (p<0.05) lower compared to numbers obtained in sows with weight ranked between 85 kg and above. The increase in the number of piglets at birth recorded in sows weighing between 85 kg and above would result from the development of the uterus, which provides more uterine space for the nesting of embryos. A positive and significant correlation (ρ= +0.82; p<0.01) was recorded between the weight of sows and the birth litter size. The weight did not have a significant effect (p>0.01) on the piglets mortality rate.

Effects of age at mating on reproductive performances in pig

It showed that the gestational length, the weaning litter size, the lactation length, the weaning-estrus interval, the number of females at weaning and the total average number of deaths was not significantly (p> 0.05) affected by the age of sows (Table 5). The birth litter sizes recorded in animals aged 7 to 8 months were comparable but significantly higher (p< 0.05) than in 6 months old animals. According to Kirk (1986), the rate of ovulation is positively correlated to the age of the animal. This ovulation rate could in the absence of certain endogenous and/or exogenous factors be associated with the increase in the size of the litter.

Table 4: Effects of weight of sow on reproductive characteristics in pig

Reproductive characteristics	Weight of sow (kg)			*p- value*
	[45-65[(n=8)	[65-85[(n=7)	85 and more (n=8)	
Gestation length(Day)	115.00 ± 0.76	114.86 ± 0.90	114.50 ± 1.19	0.58
birth litter size	5.25 ± 2.12^{c}	7.71 ± 1.16^{b}	11.00 ± 1.93^{a}	0.00
Weaning litter size	4.62 ± 2.13^{b}	5.71 ± 3.09^{b}	10.37 ± 2.13^{a}	000
Lactation length(Day)	6.25 ± 1.16	7.17 ± 0.98	6.25 ± 1.01	0.11
Weaning -estrusinterval (Day)	14.00 ± 1.00	15.00 ± 3.70	17.29 ± 3.49	0.35
Number of male at birth	2.50 ± 0.93^{b}	3.71 ± 0.95^{ab}	4.87± 1.02^{a}	0.00
Number of female at birth	2.75 ± 1.67^{b}	4.00 ± 1.00^{b}	6.12 ± 2.03^{a}	0.00
Number of male at weaning	2.37 ± 074^{b}	3.00 ± 1.73^{b}	4.75 ± 1.28^{a}	0.00
Number of female at weaning	2.25 ± 1.67^{b}	2.71 ± 1.50^{b}	5.50 ± 1.85^{a}	0.00
Stillborn piglets	0.13 ± 0.35	0.00 ± 0.00	0.00 ± 0.00	0.41
Pre-weaning mortality	0.50 ± 0.75	0.57 ± 1.13	0.63 ± 0.74	0.96
Total deathnumber	0.63 ± 0.92	0.57 ± 1.13	0.63 ± 0.74	0.99

$^{a, b,c}$ On the same line, means with the different letter were significantly different (p< 0,05). n =number of sow.

Table 5: Effects of age at mating on reproductive performances in pig

Reproductive characteristics	age at farrowing(Month)			p-value
	6 (n=7)	7 (n=6)	8 (n=10)	
Gestation length(Day)	115.17 ± 0.75	111.70 ± 1.88	114.60 ± 0.55	0.53
birth litter size	667 ± 2.16^{b}	8.40 ± 1.82^{a}	9.50 ± 2.65^{a}	0.00
Weaning litter size	4.50 ± 2.43	7.40 ± 2.43	8.00 ± 3.88	0.13
Lactation length(Day)	6.50 ± 1.22	6.20 ± 1.09	6.64 ± 1.01	0.74
Weaning -estrusinterval (Day)	15.50 ± 0.71	15.50 ± 3.79	16.67 ± 3.28	0.80
Number of male at birth	2.17 ± 0.75^{b}	4.60 ± 1.51^{a}	4.09 ± 1.30^{a}	0.00
Number of female at birth	2.50 ± 1.64^{b}	3.80 ± 1.01^{ab}	5.36 ± 2.16^{a}	0.02
Number of male at weaning	2.17 ± 0.75^{b}	4.20 ± 1.31^{a}	4.00 ± 1.41^{a}	0.02
Number of female at weaning	2.33 ± 1.86	3.20 ± 1.30	4.72 ± 2.24	0.70
Stillborn piglets	0.00 ± 0.00	0.20 ± 0.45	0.00 ± 0.00	0.13
Pre-weaning mortality	0.17 ± 0.41	0.80 ± 0.84	0.57 ± 0.94	0.44
Total deathnumber	041 ± 1.17	1.00 ± 0.45	0.94 ± 0.25	0.29

$^{a, b}$ On the same line, means with the different letter were significantly different (p< 0,05). n =number of sow.

The relationships between some reproductive characteristics

Table 6: Relationships between some reproductive characteristics

Caracteristics	WP (kg)	AP (month)	GL (day)	CN	CLS	CWP (kg)	WN	CWI (week)
WP (kg)	1							
AP (month)	0.777**	1						
GL (day)	-0.477*	-0.269	1					
CN	0.307	0.240	-0.523**	1				
CLS	0.824**	0.664**	-0.679**	0.393**	1			
CWP (kg)	-0.167	-0.235	0.238	-0.378*	-0.251	1		
NS	0.034	0.229	-0.113	-0.155	0.087	-0.157	1	
CWI (week)	0.013	0.110	0.062	0.078	-0.254	0,023	-0.232	1
WWP (kg)	-0.062	-0.005	0.173	-0.062	-0.350*	00261	-0.299	0.723**

WP= weight at protrusion, AP= Age at protrusion, G L= gestation, CN= calving number, CLS= calving litter size, CWP= calving weight of piglets, WN= weaning number, CWI= calving weaning interval, WWP= weaning weight of piglets.
(-) Negative correlation; (+) positive correlation; (**)high correlation; (*) low Correlation

Conclusion

At the end of this studyon the effects of ages, body weights and parity on reproductive characteristics in pigs,it is noted that reproductive characteristics values change withage at mating, body weight and parity. All values of reproductive characteristics considered were in the interval mentioned by previous authors in Naima hybrid.

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