Effect of lambing season, year, sex and birth status on weaning and post-weaning growth performance of Merino lambs

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Abstract

A three- year study was conducted at the Kokstad Research Station to investigate the effect of three lambing seasons, year, sex and birth status on the growth performance of Merino ewe and lambs. Data was collected over 3 years (2017-2019) using a total of 226 lambs born in autumn (AL 86), spring (SL 71), or year-round (YR 69) lambing seasons. Lambs born in spring were 1.0 kg heavier (*P<0.001*) than those born in AL and YR (0.6 kg) at birth (0 days). Lambs born in SL (3.4 kg) and AL (2.9 kg) were heavier (*P<0.001*) than those born in YR at weaning weight (90 days). Moreover, lambs born in AL (4.1 kg) and YR (3 kg) were heavier (*P<0.001*) than those born in SL at post-weaning (180 days). Male lambs were 0.4, 1.3 and 1.2 kg heavier (*P<0.05*) than female lambs at birth (0 days), 90 and 180 days, respectively. Lambs born as singles were 0.6, 1.6 and 2.3 kg heavier (*P<0.001*) than those born as twins at birth (0 days), 90, and 180 days. The year of lambing had a significant (*P<0.001*) effect on birth, weaning and post-weaning live weights. Lambs born in 2018 had a higher birth weight of 0.7 kg than 2017 and 2019, respectively. Lambs born in 2017 were 6.0, 4.0, 9.8 and 5.1 kg heavier than those born in 2019 and 2018 at 90 and 180 days respectively. Lambs born in the AL had a higher (*P<0.001*) weaning average daily gain (ADG) of 58.5 and 47.4 g/day than the lambs born in the SL and YR treatments. In contrast, lambs born in YR had a higher post-weaning ADG (27.9 and 66.3 g/day) than lambs born in AL and SL (*P<0.001)*. The male and single lambs gained 5.8 and 12.8 g/day more than lambs born female and twins at 90 days. The effect of sex and birth status of lambs was not significant on post-weaning ADG (*P>0.05*). Lambs born in 2017 gained more pre-weaning 67.5 and 58.5 g/day and post weaning 47.5 and 30.2 g/day than those born in years 2019 and 2018.

Keywords: birth weights, weaning weights, 180 day weights, average daily gain.
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Introduction

Sheep production has been of great importance to the livelihood of the people of KwaZulu-Natal (KZN), through the provision of meat and wool. Woollen sheep production is predominant in the highland areas of KZN under the grassland biome. According to the national livestock statistics, about 720 000 sheep are found in KZN province (DAFF, 2017). Out of 720 000 sheep in this province, only 1% contributed to South Africa`s wool clip (Anon, 2017). The contribution by communal sheep farmers to the provincial wool clip is minimal due to poor genetic resources, lack of controlled breeding season and inbreeding. In the KZN grasslands, flocks in communal areas have a potential to significantly contribute to the country`s wool production if good breeding strategies can be implemented. Sheep production in communal areas is characterized by a year round breeding system under an extensive production system (Mapiliyao, 2010). The East Griqualand region of the KZN is the top wool-producing region followed by Utrecht (NWGA and RPO, 2014). However, in other countries such as New Zealand; United States of America and in commercial farming systems in South Africa continuous mating system is practised in intensive sheep production system characterised by the use of cultivated pastures (Van Wyk, 2011). In KZN generally, there has been a sharp decline in sheep numbers in the province due to stock theft, predation and the other environmental contributing factors (van Tonder, 2020). In addition to these factors, poor grazing conditions in winter and the high cost of protein supplementation to fill fodder gaps during critical periods, such as winter, remain a challenge to the communal sheep production systems.

Continuous mating systems have been widely utilized globally by the sheep industry to boost flock numbers to meet economic and consumer demand for sheep products in countries such as United States of America (Lewis *et al*., 1996), New Zealand (De Nicolo, 2007) and South Africa (Brand *et al*., 2014). There

has been a paradigm shift in the world wool markets over the past five years which has been caused by drought and the decreasing sheep numbers in Australia and New Zealand (Wilcox, 2018). This has led to a growing demand for the South African wool clip by Asian (China) and European Union markets (Czech Republic and Italy) (DAFF, 2017), which has resulted in increased prices for sheep products such as wool (De Beer, 2018). The surging global demand for wool has enticed both commercial and communal sheep farmers in South Africa to increase their wool flocks in order to benefit from better wool prices (Nkamisa, 2020). Therefore, in response to the global demand for wool, there is a need to characterize the growth performance of Merino lambs bred in communal breeding systems (year round) compared to two commercial breeding systems (autumn and spring seasons).

The common breeding seasons for commercial sheep production in the East Griqualand region of KZN are in summer (from November to the end of January – autumn lambing) once a year on veld, autumn (April to June on veld – spring lambing) and in spring (September and October on planted pastures (oat) – autumn lambing), with the most common lambing season in March and April (autumn) on veld (Lyle *et al*., 2000). The above breeding seasons are well adopted by the commercial sector which has sufficient resources in terms of feed availability and utilization of winter and summer supplements throughout the year (Lyle *et al*., 2000). Resource limited communal farmers usually breed their free ranging flock throughout the year (year round) (Edea *et al*., 2012). However, there is a paucity of information on the effect of breeding sheep out of season in the East Griqualand area of KwaZulu-Natal. Hence, the aim of this study was to evaluate the effects of lambing season (autumn, spring and year-round) on the reproductive and growth performance of Merino ewes and lambs.

Materials and methods

The trial was conducted on the Kokstad Research Station (S30º 31´12.86, E29º 24´36.78) located three kilometres outside the town of Kokstad in the East Griqualand region of KZN. The average annual rainfall is 800 mm and altitude is 1340-1830 m above sea level. The vegetation of Kokstad Research Station is classified into two types: Gs12-East Griqualand Grassland and Gs10-Drakensberg Foothill Moist Grassland (Mucina & Rutherford, 2006). The trial was conducted over 3 years, namely 2017-2019, using lambs born from the three lambing seasons from a total of 107 Merino ewes (30 autumn (AL), 30 spring (SL), and 47 year-round (YR).

Ewes designated to lamb in autumn were mated and lambed on veld, raised lambs for about two months on veld before transferred to planted pastures until weaning at 90 days. Ewes designated to lamb in spring were mated on veld and lambed on planted pasture where they were raised for about two months before going onto the veld. Ewes designated to lamb in the year round were mated continously and lambed on veld, raised lambs on veld and supplemented with *Eragrostis* hay and also allowed to graze crop residues depending on the season of birth. Body weight and body condition score of ewes were taken monthly over the period of three years. A total of 226 lambs were born out of the three treatments over the trial period of three years. At birth, lamb identification number, sex, and birth status were recorded for each lamb. The lambs were weighed within 24 hours of birth and subsequently monthly until weaning (90 days) and post-weaning (from 90-180 days). Lambs born in autumn were reared on veld for two months (April and May) then taken to the predominatly oats cultivated pastures until weaning and the post weaning (180 days) trial period. Spring born lambs were reared on cultivated pastures for two months and transferred to the veld in early November until weaning and the post weaning trial period. The stocking rate (SR) applied for the study was set at the recommended SR for veld and pastures, which was low.

The oats pastures (Le tucana variety) were planted with single superphosphate fertilizer in early March every year under irrigation (15 ha) and dryland (7 ha). The AL lambs were weaned at the end of July each year and remained on pasture until end of October. Pastures were fertilized with Lime Ammonium Nitrate fertilizer after grazing. No concentrate supplementation was offered for autumn, spring and year-round born lambs during the study. Ewes were dosed for internal parasites with Nem-a-rid® 3.75% (Levamisole Hydrochloride 3,75 % m/v Rafoxanide 3,75 % m/v) and Startect® (Derquantel 10mg/ml (1% m/v) Abamectin 1mg/m (0,1 % m/v))l. All lambs were dosed with Lintex-L when weaned at 90 days. All sheep on the trial were vaccinated against pulpy kidney and bluetongue. The average daily gain (ADG) was determined from birth to weaning and post weaning from weaning to 180 days of age. Wool production was measured in the study, however in this paper, the production, reproductive performance of ewes and growth performance of lambs will only be reported on.

The data from the three lambing seasons was analysed using GenStat, 18th edition statistical software (Payne *et al*., 2016). Data analysis utilized an unbalanced design (Genstat regression) to analyse birth weight, pre- and post-weaning weight, pre-and post- ADG. Treatment means were compared at the 5% level of significance.

Table 1 Rainfall and average monthly temperatures over 3 years (2017-2019)

Months	Rainfall (mm) 2017	Temp °C 2017	Rainfall (mm) 2018	Temp °C 2018	Rainfall (mm) 2019	Temp °C 2019
Jan	130.8	26.8	220.7	28.5	74.4	28.4
Feb	289.6	26.4	70.1	28.1	237.7	27.2
Mar	80.5	28.8	159.8	26.3	109.2	27.0
Apr	46.0	24.2	16.8	24.8	145.5	23.3
May	44.7	22.2	13.2	22.0	9.91	24.2
Jun	0.25	22.1	0	21.5	0.76	22.2
Jul	0	21.4	12.7	20.5	0	22.6
Aug	1.20	21.2	42.4	21.0	0	23.3
Sept	11.7	25.5	39.1	24.3	0	25.6
Oct	143.8	23.6	40.4	25.0	1.52	27.6
Nov	110.5	24.7	47.0	27.0	3.81	27.9
Dec	122.2	24.9	85.6	28.3	10.9	26.9
Total	**981.3**	**24.3**	**747.8**	**23.1**	**593.7**	**25.5**

Results and discussion

Effect of lambing season, sex and birth status on birth and weaning live weight of Merino lambs

Lambs born in SL were 0.6 and 1 kg heavier (*P<0.001*) at birth than those born in the YR and AL respectively. This could be ascribed to the fact that spring lambing ewes were grazing good quality planted pasture in winter while pregnant and first spring rains could have also improved the grazing condition of the veld as reflected by the rainfall data in Table 1 and productivity data in Table 2. Male lambs were 0.4 kg heavier than females at birth (Table 2). This finding is consistent with other studies where male lambs were heavier at birth than females (Brand *et al*. 2014, Norouzian, 2015). Single-born lambs were 0.8 kg heavier (*P<0.001*) than twin-born lambs at birth. Findings of this conform with those of Oldham *et al* (2011) in Western Australia that improving the nutrition of Merino ewes during pregnancy increases birthweight and this leads to improved survival of their progeny. Autumn and spring born lambs were 3.1 and 3.6 kg heavier (*P<0.001*) at weaning respectively, than the year-round (Table 2). The observed heavier weights of the autumn lambs was also previously reported by Lyle *et. al*. (2000) who worked on the same study site. The higher SL results could be explained by seasonal differences in terms of lambing seasons as well as planted pasture could also be a contributing factor to the improved weaning weights at 90 days and differences in dam's milk production. Lambs born in SL were 4.1 and 3 kg lighter at 180 days than those born in AL and YR respectively (Table 2). This could be attributed to post-weaning stress which may coincide with high gastrointestinal nematodes infestations in the summer season. The combination of these factors might have resulted in lower feed intake and ultimate lower post-weaning weight gain in SL lambing- born lambs. Similar to the current study, Yimaz *et al*. (2007) and Norouzian (2015) found that both male and single born lambs showed significantly higher (*P<0.001*) weaning and post weaning weights compared to females and twin born lambs. Single and twin lambs born year round had lower weaning weight than the AL and SL.

Effect of lambing season on ewes live-weight and body condition score

Ewes in AL were (3.6 and 5.1kg) heavier than SL and YR over the 3 years (Table 2). This could be due to the adaptation and suitability of the AL system in the East Griqualand region of KZN. On the other hand, this could be attributed to the variation of species composition and diversity on the veld rotational grazing camp system where AL ewes were grazing. The BCS of the autumn lambing ewes were 0.2 and 0.3 points better than SL and YR (Table 2). Moreover, this can be explained by veld seasonal dynamics and oats pasture availability during critical periods. Therefore, the ewe weight and BCS for the year round lambing were lower

than the other treatments which would indicate that it was responsible for the poorer pre-weaning weights in the year round born lambs treatment.

Table 2 Effect of lambing season on ewe body weight, body condition score and birth, weaning and post-weaning weight (kg ±s.e.) of Merino lambs (n =226)

Lambing season 2017-2019	Ewe weight	Ewe BCS	No of lambs	Birth (0 days)	Weaning (90days)	Post-weaning (180 days)
Autumn	57.1^{c}±0.3	3.7^{b}±0.02	86	3.4^{a}±0.1	25.8^{b}±0.4	32.8^{b}±0.6
Spring	53.5^{b}±0.3	3.5^{a}±0.02	71	4.4^{b}±0.1	26.3^{b}±0.5	28.7^{a}±0.6
Year round	52.0^{a}±0.3	3.4^{a}±0.02	69	3.8^{a}±0.1	22.7^{a}±0.5	31.7^{b}±0.7
Sex of lambs						
Male			108	4.1^{b}±0.1	25.8^{b}± 0.4	31.6^{b}±0.5
Female			118	3.7^{a} ±0.1	24.4^{a}± 0.4	30.4^{a}±0.5
Birth status						
Single			154	4.1^{b}±0.1	25.6^{b}± 0.3	31.6^{b}±0.4
Twin			72	3.5^{a}±0.2	23.7^{a}± 0.5	29.3^{a}±0.8

Values in the same column with different superscript (a, b) differ significantly (*P<0.05*).

Effect of year on birth, weaning and post- weaning live weight

The year of lambing had a significant (*P<0.001*) effect on birth, weaning and post-weaning live weights. The birth weight of lambs was higher in 2018 (0.7 kg) than in both 2017 and 2019 (Table 3) . The differences in the birth weight of lambs could be as a result of seasonal variations in terms of rainfall and veld grazing conditions over the years (Table 1). The weaning weight of lambs born in 2019 were 2 and 4.7 kg lighter than those born in 2018 and in 2017 (Table 3) respectively. The post-weaning weights of lambs follow similar trends where lambs born in 2019 were 5.1 kg lighterand 9.8 kg lighter than those born in 2018 and 2019, respectively. This could be due to a crown rust disease infection of the planted pastures (oats), which could have led to forage yield losses (van Niekerk *et al*. 2001) in the 2018 and 2019 years.

An interaction between birth weight, lambing season and year was significant (*P<0.001*). The SL born lambs were 1.1 and 0.8kg heavier than AL and YR on birth weight in both 2017 and 2018, which could be attributed to the fact that SL ewes grazed from 2 to 4 months of their pregnancy on oats pasture throughout the study period which may have influenced the lamb birth weight in both years. On the other hand, in 2019, AL born lambs were 0.9 and 0.8kg heavier at birth than those of the SL and YR treatments, respectively. These results could be explained by the crown rust infection which may have reduced the oats pasture yield, affecting the pregnant SL ewes and their lamb`s birth weight. Moreover, previous studies in South Africa and elsewhere reported severe yield losses of between 30 and 85% due to crown rust infection in forage oats varieties (Griffey *et al*., 1994; van Niekerk *et al*., 2001). An interaction effect of lambing seasons and year on weaning weight was significant (*P<0.001*). The AL and SL born lambs were heavier at weaning in 2017, 2018 than in 2019. In contrast, YR born lambs had higher weaning weights in 2017 than in 2018 and 2019. An interaction between lambing seasons and birth status on weaning weight was significant (*P<0.001*).

Table 3 Effect of lambing year on birth, weaning and 180 day post-weaning weight ((kg ±s.e.)

Year of lambing	No of lambs	Birth (0 days)	Weaning (90 days)	Post-weaning (180 days)
2017	86	3.6^{a}±0.1	27.9^{c}±0.4	35.4^{c}±0.6
2018	71	4.3^{b}±0.1	23.9^{b}±0.4	30.3^{b}±0.6
2019	69	3.6^{a}±0.1	21.9^{a}±0.6	25.6^{a}±0.6

Values in the same column with different superscript (a, b) differ significantly (*P<0.05*)

Effect of lambing season on weaning and post- weaning average daily gain of Merino lambs

Growth rates for lambs post weaning across all lambing seasons declined due to weaning and the cessation of milk feeding. The ADG of lambs born in AL was 47.4 g/day more than (*P<0.001*) the weaning ADG for the SL treatment lambs and the 58.5 g/day for the YR treatment lambs (Table 4). The results in this study are in agreement with those of Lyle *et al*. (2000) who reported good pre-weaning ADG's of AL lambs raised on oats pastures in the same study area. The lambs born in the YR treatment had higher ADG 27.9 g/day than those of the AL and SL 66.3 g/day treatments. These findings suggest that spring-born lambs could not adapt well to the seasonal changes from a planted pasture to summer veld. On the other hand, there could be a possibility of gastrointestinal parasite infestation in this group as characterized by their poor growth performance during the rainy season. The male and single born lambs had a significantly higher pre-weaning ADG of 5.8 and 12.8 g/day than the female and twins born lambs respectively.

Table 4 Weaning and post-weaning average daily gain (ADG g/day (±s.e.)) of Merino lambs

	Production parameters		
Lambing season 2017-2019	**No of lambs**	**Weaning (0-90 days)**	**Post-weaning (90-180 days)**
Autumn	86	265.5^{b}±6.0	66.8^{b}±4.6
Spring	71	218.1^{a}±4.6	28.4^{a}±4.6
Year Round	69	207.0^{a}±4.5	94.7^{c}±5.2
Sex of lambs			
Male	108	236.4^{b}±4.0	63.2^{a}± 3.8
Female	118	230.6^{a} ±4.0	55.6^{a}± 4.0
Birth status			
Single	152	237.2^{b}±3.3	63.5^{a}± 6.2
Twins	72	224.4^{a}±5.4	57.3^{a}± 3.0

Values in the same column with different superscript (a, b) differ significantly (*P<0.05*)

Effect of year on weaning and post-weaning average daily gain

Year of lambing had a significant (*P<0.001*) effect on weaning and post weaning ADG. The weaning ADG of lambs born in 2017 was 67.5 g/day and 58.5g/day higher than those born in 2019 and 2018 (Table 5), respectively. This could be attributed to the higher rainfall in 2017 (233.5 and 387.6 mm) more than in 2018 and 2019 which could led to good veld grazing conditions (Table 1). The post-weaning ADG of lambs born in 2017 gain 30.2 g/day and 47.5g/day more than those born in 2018 and 2019 (Table 5), respectively.

Table 5 Effect of lambing year on weaning and post- weaning ADG (g/day) (±s.e.) of Merino lambs

Year of lambing	**No of lambs**	**Pre-weaning (90 days)**	**Post-weaning (180 days)**
2017	86	270.1^{b}±4.5	82.6^{c}±4.8
2018	71	211.6^{a}±4.6	52.4^{b}±4.5
2019	69	202.6^{a}±6.0	35.1^{a}±5.1

Values in the same column with different superscript (a, b) differ significantly (*P<0.05*)

Effect of lambing season on lambing distribution per month over three years.

The YR ewes had a higher number of lambs born at the beginning of the trial in 2017 (Figure 1). However, there was a sharp decline in the number of lambs born in the YR treatment from the second (81%), third (45%), fourth (69%) and fifth (62%) lambing in November 2017, January and August 2018 and April 2019, respectively. This results in YR ewes treatments could be attributed to poor recovery of body condition score, poor mothering ability and high incidence of lamb rejection after lambing. The results of the study were supported by low reproductive efficiency of this systems (Table 6).

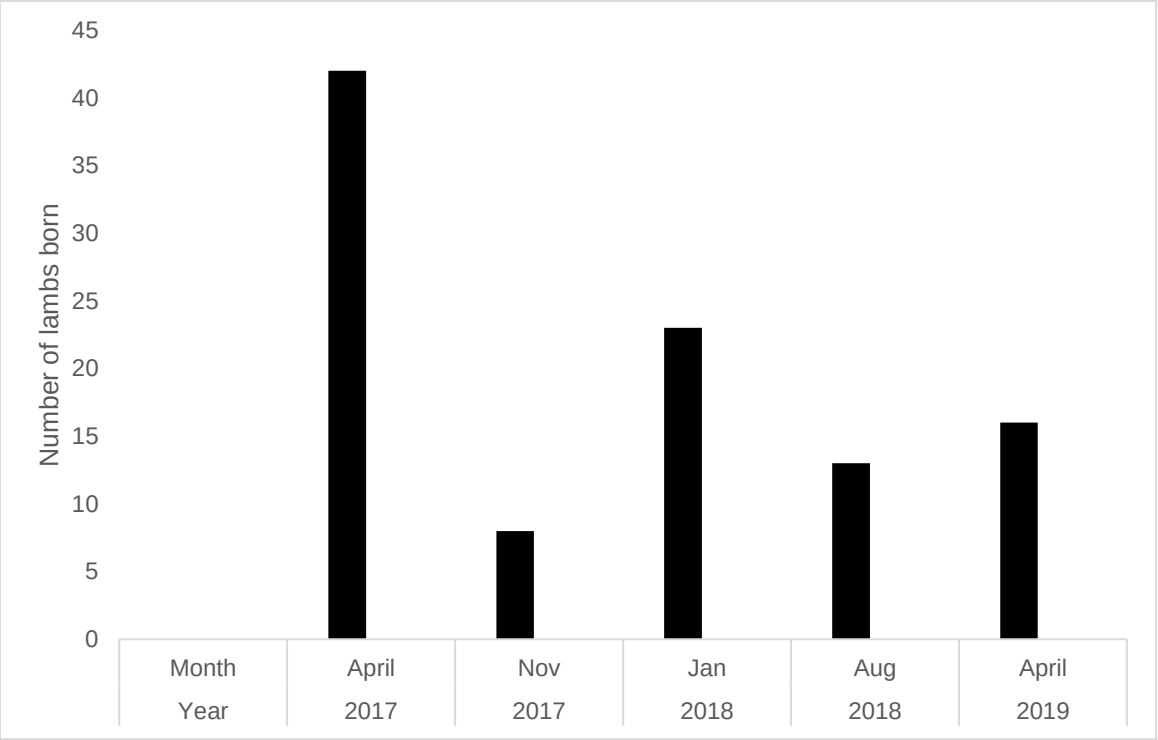

Figure 1 Lambing distribution of ewes in all year round over the 3 years

Effect of lambing season on ewe fertility and lamb mortality

The effect of lambing season on the productivity of the ewes (Table 6) indicates that the year round lambing treatment had the lowest conception rates (58.4%) and weaning percentage (65.7%), as well as a relatively high lamb mortality rate (34.7%), peaking in the summer months. Results showed that the combination of these factors can have a negative impact on the productivity of communal flocks lambing year round. The results of this study on year round lambing treatment are in agreement which those reported by Mapiliyao *et al*. (2012) on conception at birth (49%) and mortality (22%) rates in the sourveld (Sompondo) areas of the Eastern Cape, as well as Msuntsha & van Zyl (2019) who also reported high mortalities (42.4%) in the sandy sourveld of Nothern KwaZulu-Natal. In earlier studies of communal sheep production Bembridge(1989) reported a reproductive rate (±56%) and mortality rate (±25%) in the former Ciskei region of the Eastern Cape. Also, considering that the stocking rates for this study were set at the recommended SR's on veld, the higher SR's generally found on communal grazing would increase the negative impact of the year round lambing season on ewe productivity.

Table 6 Reproduction and production performance of ewes

Parameter	Lambing seasons groups		
	Autumn lambing	**Spring lambing**	**Year round**
Conception rate (%)	80	81.1	58.4
Weaning %	97.7	83.0	65.3
Lamb mortality (%)	3.3	17.0	34.7

Conclusion

The results suggest that SL born lambs tend to perform better from birth to weaning (90 days) than those lambs born in autumn and year round. However, spring born lambs performed poorly post-weaning at 180 days as compared with autumn and year round lambs. Poor performance by spring born lambs was a discrepancy; and it is suggested that, further investigation on gastrointestinal nematodes is needed to quantify the performance of spring born lambs post-weaning. Surprisingly, year-round born lambs outperformed both

autumn and spring-born lambs in terms of growth rates post-weaning. The study also showed the influence of sex and birth status as an important trait at weaning (90 days) and post-weaning (180 days) weights of Merino lambs. Variation between years significantly influences production with lambs born in 2017 outperforming those born in 2018 and 2019 on pre-post weaning weight, pre-post ADG over the 3 years.

The low ewe reproductive efficiency and high lamb mortality over the 3 years in the YR lambing group present a key challenge with respect to growth performance of Merino lambs bred out of season in the East Griqualand region of KZN. The failure of the YR system simulating a communal sheep production system in this study was a indicator of the constraints faced by small-scale sheep farmers to make meaningful contribution to the KZN sheep industry. It is recommended that for communal farming systems serious consideration be taken to implement specific breeding and lambing seasons.

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Authors contributions

Mpumelelo Magawana was involved in conducting the research, statistical analysis, interpretaion and write up. Trevor J Dugmore was involved in the initial design of the trial and editing of the manuscript. Hannes de Villiers & Sibongiseni T Gcumisa were in involved in organising statistical consultant, manuscript design structure, editing of the manuscript and supervise the reseacher.

Conflict of interest declaration

No conflict of interest. Authors are employed by KZN Department of Agriculture & Rural Development which funded this Research. Project number AS-S08/03K.

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