RISK FACTORS ASSOCIATED WITH ABORTION AND CALF PREWEANING MORTALITY IN A BEEF CATTLE SYSTEM IN SOUTHEASTERN MEXICO†

[FACTORES DE RIESGO ASOCIADOS CON ABORTO Y MORTALIDAD PREDESTETE EN UN SISTEMA DE PRODUCTION DE CARNE BOVINA EN EL SURESTE DE MEXICO]

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SUMMARY

Data from 2438 calvings born to 682 cows recorded from 2004 to 2015 in an extensive production system were used, to investigate factors associated with abortion and calf mortality until weaning. Cows belonged to Brahman, Nellore, Guzerat and Brown Swiss x Zebu breed groups. Data were analyzed using binary logistic regression, and the statistical model included the effects of year and season of calving (or abortion), parity number, breed group of the cow and sex (only for preweaning mortality). Abortion rate was 0.99% varying from 0.61% to 1.94% among year groups. First parity and Nellore cows had the greatest abortion rates (1.66 and 1.46%, respectively). The calf mortality rate was 9.65%, varying from 3.18% to 14.65% across all years. The major factors associated ($P < 0.05$) with mortality of calves included year and season of calving, parity number and breed group of the cow. Nellore cows had the highest odds of preweaning mortality (OR=4.41). Cow parity number and season of calving were also associated with calf mortality. First parity cows had the major calf losses overall. In conclusion, closer attention to the management of first parity cows could reduce calf mortality.

Key words: Breed; parity; season; sex; tropics.

RESUMEN

Se utilizaron datos de 2438 partos de 682 vacas paridas de 2004 a 2015, en un sistema extensivo de producción, para investigar los factores asociados con el aborto y la mortalidad de terneros hasta el destete. Las vacas pertenecían a los grupos racilaes Brahman, Nellore, Guzerat y Brown Swiss x Cebú. Los datos se analizaron mediante regresión logística binaria y el modelo estadístico incluyó los efectos del año y la época del parto (o aborto), el número de paridad, el grupo racial de la vaca y el sexo (sólo para la mortalidad pre-destete). La tasa de aborto fue 0.99% variando de 0.61% a 1.94% entre los grupos de años. Las vacas de primer parto (1.66%) y de la raza Nelore (1.66 y 1.46%, respectivamente) tuvieron las tasas de aborto más altas. La tasa de mortalidad de terneros fue 9.65%, variando de 3.18% a 14.65% en todos los años. Los principales factores asociados ($P < 0.05$) con la mortalidad de los terneros fueron el año y la época de parto, el número de paridad y el grupo racial de la vaca. Las vacas Nelore tuvieron los mayores momios de mortalidad predestete (OR = 4.41). Número de paridad de la vaca y la época de parto también se asociaron con la mortalidad de terneros. Las vacas de primer parto tuvieron las principales pérdidas de terneros en general. En conclusión, mayor atención al manejo de las vacas de primer parto podría reducir la mortalidad de los terneros.

Palabras clave: época; número de parto; raza; trópico.

INTRODUCTION

Abortion in cows and mortality of calves are important causes of production losses and low profitability in livestock farms. Both traits reduce the number of calves for sale, the number of replacement heifers and cows productivity. In addition, they cause indirect losses through underutilization of equipment and infrastructure. According to Bagley (1999) cows suffer abortion rates of 1 to 2%; mainly caused by etiological

† S*ubmitted May 23, 2016 – Accepted July 05, 2018.*

agents such as bacteria, fungi and viruses (Khodakaram-Tafti and Ikede, 2005). Plasse *et al*., (1998), in Venezuela, reported abortion rates of 0.6 to 4.5% in 14 beef cattle herds. In the tropics of Mexico, there are few reports on abortion and pre-weaning mortality rates of Zebu calves (Rodríguez and Escrivá, 1971; Gonzalez-Gonzalez and Segura Correa, 1989; Segura-Correa *et al*., 2009), even though abortive diseases such as leptospirosis, bovine viral diarrhea virus, infectious bovine rinotracheitis are highly prevalent in the region (Segura *et al*., 2003, Solis *et al*., 2003, 2005). Mortality rate of calves can be influenced by sex of the calf, climate and management conditions, parity number of cow, vigor and birth weight, and genetics (Gonzalez-Gonzalez and Segura-Correa, 1989; Correa *et al*., 2000; Riley *et al*., 2001, 2004). Identification of the risk factors associated with abortion and calf mortality could aid in the optimization of herds productive efficiency. Differences in herd management, feeding systems, breed used and microclimatic conditions may causes variations in herd abortion and mortality rates. Therefore, the objective of this study was to estimate the abortion and preweaning mortality rates, and to determine the importance of some risk factors in an extensive beef cattle system under the tropical conditions of southern Mexico.

MATERIALS AND METHODS

Location

Data were obtained from a productive system located at the northeastern region of Yucatan, Mexico. Yucatan is located at the southeast of Mexico and it has a tropical sub-humid climate, with rain mainly in summer, and averages of temperature and annual rainfall of 25.8 C and 1105 mm, respectively ((INEGI, 2004).

Animals and management

Cows belonged to Brahman, Guzerat and Nellore breeds, and crosses of cows of those breeds with Brown Swiss sires. The proportion of Brown Swiss in crossbred cows was unknown. At the farm, calves were identified at birth, and they stayed with the dam until weaning (approximately at 8 months of age). Cows were managed under extensive conditions in *Panicum máximum* and *Brachiaria brizantha* grass paddocks at night (17 to 6 hours). When pasture was scare in the dry season (February to May) animals were provided with bales of forage. Pure breeds were kept in different lots. Reproduction of the herds was basically by natural mating and some were by artificial insemination. The calves were vaccinated against clostridia, bovine paralytic rabies and leptospira. External parasites were controlled with immersion baths when animals were seen with ticks and internal parasites by deworming every six months. The herd was free of brucellosis.

Abortion and mortality traits

The overall traits of interest for the present study were abortion and calf mortality from birth until weaning (preweaning mortality). Date and reason of calf mortality were not recorded regularly; therefore, reasons of death were not included in the study. In the production system, veterinary intervention and artificial rearing was not practiced

Risk factors

Information on calf, cow identification, as well as occurrence of abortion, calving date, sex of the calf, occurrence of mortality until weaning, parity number and breed of cows were obtained from the records (n=2438) of 682 cows kept for the years 2004 to 2015. Because of low incidence of abortions year of abortion data were grouped in five categories (2004-2006, 2007-2008. 2009-2010, 2011-2012 and 2013-2015). In addition and for same reason, data from cows with 2 and 3, 4 and 5 and 6 or more calvings were grouped. Based on month of the year three season were established: dry (February to May), rainy (June to September) and windy (October to January). To determine the effect of year of calving on preweaning mortality, data from 2004 to 2006 were grouped in a single category, as were those data from 2014 and 2015, due to small number of observations for those years. Seasons of calving were established based on months of the year as previously described, based on temperature and amount of rain. In addition, the data of the cows with 8 or more parities were grouped in a single category. Information on weight at birth, weaning and reproductive traits of this herd has been reported in previous studies (Segura *et al*., 2017a; Segura *et al*., 2017b).

Statistical analysis

The logit of the probability of abortion (yes, no) or preweaning dead (yes, no) was modelled using the Bayes option of the GENMOD procedure of SAS (SAS, 2010) assuming binomial distributions for both traits. The default prior used by SAS program for the fixed-effect parameters was the normal distribution. We further used 5000 burn-in iterations, 100,000 iterations after burn- in and a thinning of 5. The statistical for abortion and preweaning mortality included the fixed effects of year of calving, season of calving, parity number, cow breed group and sex (only for preweaning mortality). Referent levels of the risk factors were year 2009, dry season, sixth parity cows, crossbred cows and females. Significance of risk factors was declared at $P<0.05$. Markov chain convergence was assessed by visually checking trace,

correlation, and kernel density plots (available on request).

RESULTS AND DISCUSSION

Abortion

From the information available (n=2438) there were 24 abortions given an overall abortion rate of 0.98%. The overall abortion rate here reported is within the range of abortion losses (0.6 to 4.5%) reported by Plasse *et al*. (1998) in 14 beef herds in Venezuela. In addition, it is similar to the 1–2% acceptable values suggested by Bagley (1999) and slightly lower than that found by Segura *et al.*, 2009 (1.17%) in the same region of this study. Bagley (1999) stated that if abortion rate is greater than 3% it should be some concern about it.

Abortion could be caused mainly by infectious disease agents but also by trauma, toxins and plants. In southern Mexico, diseases associated to reproductive problems, such as leptospirosis, infectious bovine rhinotracheitis and bovine viral diarrhea are endemic in the region (Segura-Correa *et al*., 2003; Solís-Calderón *et al*., 2003, 2005). Abortion rates obtained from field data could be underestimated if abortions at early stage of gestation occurs, because the expulsion of the fetus and placental tissues may not be detected and recorded.

Abortion rates by risk factors (except year) are shown in Table 1 and their odds ratios in Table 2. Abortion rates varied from 0.61% to 1.94% among year groups and there were not season differences. Year of calving is a factor difficult to interpret; because its effect include many climatic and management changes among years, which make it difficult to interpret; however, it is recommended to be included in the statistical model to remove its confounding effect on other risk factors to be evaluated.

The lack of significant influence of season on abortion, here found, disagree with the results of Segura-Correa and Segura-Correa (2009) who found that the risk of abortion was lower in the dry seasons compared to the rainy and windy seasons (P=0.009). Those authors suggest that environmental conditions may play an important role in the presence of pathogens and in consequence on abortion.

Fist parity cows had higher frequencies of abortion (1.66%) than multiparous cows (Table 1); the odds being 3.55 times those of cows with 6 or more parities (Table 2). Higher abort in first parity cows may be explained because of hormonal and uterus recognition may not be well stablished. However, Segura-Correa and Segura-Correa (2009) reported that the risk of abortion was higher in second parity cows followed by the third and first parity cows, as compared to older cows.

In this study, Nellore cows had the highest abortion rate (1.46%), and 6.15 times higher risk than crossbred cows (Table 2). However, in a previous study, Segura-Correa and Segura-Correa (2009) in the same region did not find breed differences in abortion, corresponding the highest prevalence to the crossbred cows. Wijeratne and Stewart (1971) reported breed differences in abortions in dairy and beef cattle.

Table 1. Abortion rates by season of abortion, parity number and breed group of the cow in a beef cattle system in southeastern Mexico.

Risk factor	N	aborted	%	Exact P value
Season				
Dry	1087	12	1.11	0.1681
Rainy	623	3	0.48	-----
Windy	728	9	1.22	0.1043
Parity				
1	601	10	1.66	0.0591
2-3	834	7	0.84	0.4580
4-5	566	3	0.53	0.4992
>=6	434	4	0.92	-----
Breed group				
Brahman	497	4	0.80	0.3057
Nellore	1026	15	1.46	0.0423
Guzerat	626	2	0.32	----
Brown Swiss x Zebu	289	3	1.04	0.2917

Table 2. Posterior descriptive and statistics of regression coefficients and odds ratios by season, parity number and breed group of cow for abortion, in a beef cattle system in southeastern Mexico.

Risk factor	Beta	EE	OR	95% HPD interval
Season				
Dry	1.0296	0.7186	2.800	0.828, 12.401
Rainy	0	----	1	----
Windy	1.226	0.7510	3.000	0.865, 16.525
Parity				
1	1.2668	0.7176	3.459	0.937, 14.622
2-3	0.4998	0.7372	1.648	0.434, 7.083
4-5	0	----	1	----
>=6	0.3803	0.8504	1.463	0.308, 8.262
Breed group				
Brahman	1.0409	0.9528	2.832	0.435, 20.962
Nellore	1.8161	0.8483	6.148	1.377, 32.243
Guzerat	0	----	1	----
Brown Swiss x Zebu	1.0802	1.0842	2.945	0.418, 26.779

HPD = Highest posterior distribution (credible interval).

Preweaning mortality

Of the information available (n=2414), there were 233 deaths till weaning given a preweaning mortality rate of 9.65%. The preweaning mortality rate reported here for the cows managed under an extensive pasture system is within the range (1–12.6%) of calf losses (not including abortions) reported in 14 beef cows by Plasse *et al*. (1998).

All risk factors evaluated were significant on preweaning mortality (except sex of the calf). Incidence and odds ratios by risk factors (except year of calving) for preweaning mortality are shown in Tables 3 and 4. There was no trend of mortality with years; incidences varying from 3.18% to 14.65% across all years. The largest odds of preweaning mortality relative to the year 2009 corresponded to years 2014 and 2007 with odds values of 20.99 and 4.78, respectively. As mentioned before, year of calving is a factor difficult to interpret; but it must be included in the statistical analysis of the data because is an important confounding factor.

Table 3. Preweaning mortality rates by season of calving, parity number, breed group and sex of calf of cows in a beef cattle system in southeastern Mexico.

Risk factor	N	Dead	%	Exact P value
Season				0.0001
Dry	1068	77	7.21	
Rainy	620	91	14.68	
Windy	728	67	9.20	
Parity				0.0001
1	594	86	14.48	
2	461	44	9.54	
3	366	22	6.01	
4	306	20	6.54	
5	257	18	7.00	
6	190	12	6.32	
7	122	17	13.93	
>=8	118	14	11.86	
Breed group				0.0181
Brahman	493	42	8.52	
Nellore	1013	84	8.29	
Guzerat	624	80	12.82	
Brown Swiss x Zebu	286	29	10.14	
Sex				0.1422
Female	1251	111	8.87	
Male	1165	124	10.64	

Table 4. Posterior descriptive and statistics of regression coefficients and odds ratios by season calving, parity number and breed group of cow for preweaning mortality, in a beef cattle system in southeastern Mexico.

Risk factor	Beta	EE	OR	95% HPD interval
Season				
Dry	0	----	1	----
Rainy	0.9523	0.1788	2.592	1.856, 3.735
Windy	0.2889	0.1905	1.335	0.941, 1.982
Parity				
1	1.3935	0.3563	4.029	2.038, 8.002
2	0.8385	0.3696	2.313	1.134, 4.723
3	0.3197	0.4031	1.377	0.629, 3.002
4	0.3461	0.4064	1.414	0.656, 3.207
5	0.3337	0.4146	1.396	0.625, 3.15
6	0	----	1	----
7	0.7235	0.4248	2.062	0.914, 4.721
>=8	0.3230	0.4455	1.381	0.575, 3.206
Breed group				
Brahman	0.9803	0.3005	2.665	1.486, 4.790
Nellore	1.4837	0.2827	4.409	2.626, 7.823
Guzerat	0.8965	0.2725	2.451	1.433, 4.147
Brown Swiss x Zebu	0	----	1	----
Sex				
Male	0.1476	0.1482	1.159	0.865, 1,549
Female	0	----	1	----

HPD = Highest posterior distribution (credible interval).

Mortality was greatest in the rainy season as compared to the dry season. The odds of mortality of a calf born in the rainy season was 2.59 times that of a cow calving in the dry season. The results of this study disagree with those of Rodriguez and Escrivá (1971) and Gonzalez-González and Segura-Correa (1989) in Brahman cattle in Mexico who did not observed differences among seasons. However, both reported a higher mortality rate in the rainy season as compared to the dry season as observed here. As mention before environmental conditions may play an important role in the incidence of pathogen agents, because warm and humid conditions favor their proliferation and distribution.

First parity cows had greatest calf losses (14.48%) with odds approximately 3-times those for multiparous cows. These results are similar to those reported by Gonzalez-González and Segura-Correa (1989) who found an influence of parity in mortality. However, the mortality rate for first parity cows observed by those authors was slightly lower 12.2%. The reasons of a greater mortality in first parity cows was not determined, in this study; however, the results suggest the need of greater attention and better management for those type of females. In addition, old cows tend to have higher mortality than middle age (parity) cows (Tables 3 and 4). Schmidek *et al*. (2013) reported that preweaning mortality was higher among calves born from cows aged ≤3 and ≥11 years at calving compared with cows aged 7 to 10 years. Therefore, herd owners should give greater attention to first parity cows to reduce calf mortality ensuring that heifers achieve target body conditions score and body weight at first calving (Mee *et al*., 2008).

Sex of the calf was not an important risk factor on mortality till weaning as have been reported by others authors in Zebu cattle in Mexico (Rodríguez and Escrivá, 1971; Gonzalez-González and Segura-Correa, 1989). Schmidek *et al*. (2013) observed that male calves presented less vigor and higher preweaning mortality than Nellore female calves. Nevertheless, in a previous study with same data here used, birth weight of calves were similar among pure and crossbreed cows (Segura *et al*., 2017a).

Guzerat had the greatest mortality rate (12.82%) follow by crossbred cows (10.14%), and Nellore cows had the lowest mortality. However, adjusted OR (from binary logistic regression) showed lowest risk of mortality for Nellore cattle (Tables 3 and 4). This is explained because mortality rates in Table 3 are crude percentage, whereas breed OR values in Table 4 are adjusted by season, parity and sex confounding effects. The mortality for Brahman cows, in this study (8.52%, at 7 months), is higher than that reported (7.0% at 9 months) by Gonzalez-González and Segura-Correa (1989) in Tamaulipas, Mexico; and that of 5.1% at 7 months observed by Rodriguez and Escrivá (1971) in "La Huasteca Potosina", Mexico. In addition, the mortality rate, here found, is higher than that reported

for Nellore cattle (4.6%) by Correa *et. al*. (2000) in Brazil. According to Benjaminsson (2007) among the factors that might affect mortality rate until weaning in cattle are parity number, sex of the calf, age at first calving, length of gestation, sire of calf and inbreeding. Here the importance of recording information on mortality and risk factors associated to it, in order to prevent calves losses. However, this should be accompanied with the recording of the reason of calf death. In addition, this study was carried out in a representative type farm; therefore, the results here obtained could be extrapolated to other farms in the region. Reducing preweaning mortality in a given farm will increase its profitability by weaning more calf for sale and replacement.

Some of the significant risk factors here studied are largely not under management control of the farm owner (v. gr. year of calving and season of calving). However, attention should be given to key determinants under the owner control, such as first parity cows, infectious diseases, age at first calving and body condition, to reduce abortion and preweaning mortality of zebu cattle, under the tropical conditions of this study.

CONCLUSION

The overall abortion rate here found is in the lower limit of values reported in other studies in the literature; however, preweaning mortality rate is relatively high, which means that it could be reduced with better management practices. Season, parity number and breed group were significant risk factors on preweaning mortality. However, only breed group effect was significant on abortion rate. Closer attention to the management of first parity cows could reduce calf mortality.

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