



Original Articles

Analysis of the efficiency of active immunization against IBR, BVD and leptospirosis in increasing pregnancy rate in FTAI protocols

Análise da eficiência da imunização ativa contra IBR, BVD e Leptospirose para elevar a taxa de prenhez em protocolos de IATF

Gabriela de Souza Sartori¹ , Gabriel Rodrigo Hass Perucchi¹ , Diego Rodrigues Pereira²  Danila Fernanda Rodrigues Frias¹ 

¹ Universidade Brasil, Campus Fernandópolis

² Médico Veterinário Autônomo

ARTICLE INFO

Article history

Received 18 February 2020

Accepted 02 April 2020

Keywords:

Body condition

Reproductive diseases

Zebu dams

Palavras-chave:

Condição corporal

Doenças reprodutivas

Matrizes zebuínas

ABSTRACT

Beef cattle farming is a highly representative activity for the GDP of Brazil, rendering the country an important producer of beef. For Brazil to maintain this prominent position, sanitary management actions must be carried out, such as the control of reproductive diseases. This study examines the effectiveness of vaccination against reproductive diseases in bovine females. Data from 8752 Zebu cows on the status of vaccination against reproductive diseases, body condition score (BCS) and the subsequent result of pregnancy diagnosis were evaluated. With regard to BCS, primiparous was the category that most demonstrated the effect of body condition on pregnancy rate, with BCS 3.5 cows having a 30% higher rate than the animals with BCS 2. In the group of nulliparous cows, those with BCS 3.5 had a pregnancy rate of 58% vs. 46% in BCS 3 cows. The induced nulliparae with BCS 3.5 had a 9% higher pregnancy rate than those with BCS 3. Multiparous cows also had a 9% higher rate when their BCS was 3.5 as compared with BCS 2. Among the evaluated dams, 46.5% were vaccinated against IBR, BVD and leptospirosis. Of these, the primiparae showed a 21% increase in conception as compared with the non-vaccinated group; multiparae, 10%; nulliparae, 5.9%; and induced nulliparae, 7.8%. In conclusion, BCS directly influences the reproductive efficiency of bovine females, and the use of vaccination against reproductive diseases can be recommended. However, this indication must be based on epidemiological and animal-performance data of each farm.

RESUMO

A bovinocultura de corte é muito representativa para o PIB brasileiro, tornando o país um importante produtor de carne bovina. Para manter este patamar ações de manejo sanitário devem ser executadas, dentre elas o controle de doenças reprodutivas. O presente trabalho teve por objetivo avaliar a eficácia do uso de vacinas contra doenças reprodutivas em fêmeas bovinas. Para isso foram avaliados dados de 8752 fêmeas bovinas zebuínas. Os dados analisados foram referentes à condição vacinal contra doenças reprodutivas, escore de condição corporal (ECC) e posterior resultado do diagnóstico de gestação. Com relação ao ECC, primípara foi a categoria que mais demonstrou o efeito do ECC na taxa de prenhez, com ECC 3,5 apresentou índice 30% superior a animais com ECC 2. Nulíparas apresentaram 58% com ECC 3,5 em comparação ao ECC 3, 46%, assim como as nulíparas induzidas, que com ECC 3,5 apresentaram taxa de prenhez 9% superior as com ECC 3. As múltiparas também apresentaram 9% a mais de prenhez quando possuíam ECC 3,5 em comparação ao ECC 2. Dentre as matrizes avaliadas, 46,5% foram vacinadas contra IBR, BVD e leptospirose. Destas, as primíparas, apresentaram 21% de aumento na concepção nas vacinadas, assim como as múltiparas que apresentaram 10%, nulíparas 5,9% e nulíparas induzidas 7,8%. Assim concluiu-se que o ECC influencia diretamente na eficiência reprodutiva das fêmeas bovinas e que o uso de vacina contra doenças reprodutivas pode ser indicado, porém esta indicação deve ser baseada em dados epidemiológicos e zootécnicos de cada propriedade.

* Corresponding author: helderpereirap@yahoo.com.br

INTRODUCTION

At present, Brazil is considered an important producer of beef, both nationally and internationally. The country has about 214 million head of cattle, 44 million of which are slaughtered annually and produce about 11 million tons of carcass equivalent. Only 20% of the produced meat is exported, the rest being consumed by the domestic market (ABIEC, 2019).

The economic figures of Brazilian beef cattle farming reveal a market that accounts for 6% of the national GDP, 30% of the GDP from agribusiness and 3% of Brazilian exports in general. Its growing rise *was* and *is* possible thanks to modernization in the genetic field, investments in pasture management and pest control, which have caused its extraction rate (slaughtered head/total inventory) to increase from 15% to 25% (CHIARI; GOMES; FEIJÓ, 2017).

Thus, when one regards production and productivity, it is worth stressing the importance of factors that directly and indirectly interfere with the reproductive aspect of the system. Among them are *nutritional management*, which is closely linked to body condition score, which predicts the energy uptake of an animal and how able it is to undergo the reproductive cycle; *animal welfare*, which is measured based on the principle of "five freedoms" (freedom from hunger/thirst, discomfort, pain, fear/distress and freedom to express its natural behavior), since the cortisol released due to stress is the obstacle to the animal's cyclicity; *selective breeding*, which increases animal efficiency; *herd productivity control*, which allows the assessment of rearing effectiveness, helping in the culling and selection of animals; and, lastly, *sanitary management* (ALFIERI, 2017; BREEN, 2005; COSTA-E-SILVA et al., 2010; PARRA; BELTRAN, 2008).

Among the disorders that affect bovines, reproductive diseases are highlighted as true obstacles in the production cycle. A few noteworthy affections of this nature are leptospirosis, brucellosis, infectious bovine rhinotracheitis (IBR), bovine viral diarrhea (BVD), trichomonosis, campylobacteriosis and neosporosis (ALFIERI; ALFIERI; ALFIERI; ALFI 2017).

Leptospirosis, IBR and BVD are the most prevalent conditions in the national herd, in addition to being considered endemic. This fact is related to the pathogens that cause IBR to be able to generate latent infections, making the individual a viral carrier for life. In, BVD the causal agent produces persistently infected animals. Lastly, in the case of leptospirosis, the individual evolves to a chronic condition in which it becomes a renal carrier that eliminates the disease for years (CHIDEROLI et al., 2016; DIAS et al., 2010; OTONEL et al., 2014; TAKIUCHI et al., 2005).

To address these problems, some prophylactic measures can be implemented such as the adoption of reproductive technologies like Artificial Insemination,

which helps to inhibit venereal transmission of these pathogens, to identify and dispose of carrier and reservoir animals on the farm, and, finally, to establish a health control program. The role of the veterinarian in developing this program is to identify risk factors, make the diagnosis and implement good management practices to improve the health and production of the herd. A diagnosis of the situation must be firstly performed, since each farm, region or country may present a different epidemiological situation, with the presence of one or more associated risk factors (DEL FAVA et al., 2007).

The use of vaccination against diseases that affect reproduction is a practice already adopted in some cattle herds. For adherence to this practice, it is important that producers be aware of the seriousness of all the problems related to the reproductive and productive efficiency of the herd not only in the clinical aspect, but mainly regarding the financial losses they entail, since this is the first step to an effective sanitary control (JUNQUEIRA; ALFIERI, 2006). On this basis, the present study was undertaken to examine the use of vaccines against reproductive diseases in bovine females aiming to improve reproduction rates.

MATERIAL AND METHODS

Data of 8752 Zebu cows that participated in the 2017/2018 and 2018/2019 breeding seasons from herds in the states of Tocantins, Goiás and Bahia were evaluated.

The analyzed data referred to the status of vaccination against reproductive diseases; body condition score (BCS); and the subsequent result of the pregnancy diagnosis. The evaluated animals were divided into the following groups: nulliparous, induced nulliparous, primiparous and multiparous.

Body condition score was determined by a visual assessment, using a scale of 1 to 5 with 0.5-point intervals where 1 indicated little muscle mass and backfat and 5 an excess of both (JAUME; MORAES, 2002).

All females were exposed to fixed-time artificial insemination (FTAI) protocols. The animals were inseminated at D11 of the recommended FTAI protocol. Artificial insemination was carried out with semen from Nellore and Aberdeen Angus bulls. Before insemination, a dose of semen from each lot was thawed and the quality of this material evaluated. After the lot of semen was released, insemination was performed by only two technicians to minimize the impact of human action on the effectiveness of the technique. After 40 days of artificial insemination, pregnancy diagnosis was performed by ultrasound.

Factors pertaining to selective breeding, performance control with active culling of unproductive dams, animal welfare and nutritional management must be analyzed, since they directly affect the pregnancy rate of herds.

However, because the evaluated herds have had a thorough veterinary medical follow-up with regard to these requirements for over ten years, these variables were not considered in this study.

After the collected data were tabulated, two statistical analysis functions were performed, namely, descriptive and inferential. Then, the profile of the studied sample was drawn descriptively, considering the analyzed variables and their consequences. The data were replicated in absolute and relative values in this first part. However, in the inferential domain, the analysis of independence and prediction between the variables proposed in the scope of the work was set as a statistical objective. For this, Spearman's correlation test was used, within the expected standards. It is worth mentioning that the results of independence between the proposed variables were obtained by analyzing the *p*-values

(significance). Finally, all analyses were carried out using SPSS Statistics software (Version 23), linked to the features of the Excel tool (version 2016).

RESULTS AND DISCUSSION

Within the studied period, data of 4562 cows in the 2017/2018 breeding season and 4190 cows in the 2018/2019 breeding season were evaluated.

These animals were divided into five categories, namely, nulliparous - animals that never conceived; induced nulliparous - animals that never conceived and that underwent hormonal pre-induction before the start of the breeding season; primiparous - animals that conceived once; and multiparous - animals in active reproduction after the first calving. The number of individuals per category is shown in Table 1.

Table 1: Number of females evaluated in the 2017/2018 and 2018/2019 breeding seasons according to classification by category.

Category	2017/2018	2018/2019
Nulliparous	231	340
Induced nulliparous	534	679
Primiparous	464	407
Multiparous	3333	2764
Total	4562	4190

The use of vaccines against reproductive diseases (infectious bovine rhinotracheitis [IBR], bovine viral diarrhea [BVD] and leptospirosis) was analyzed in the two breeding seasons. Vaccination was carried out by the following protocol: dams already vaccinated in the previous year would receive a dose of the vaccine 30

days before the start of the breeding season, whereas those to be vaccinated for the first time would receive a dose 60 days before the start of the breeding season and a booster dose 30 days after the application of the initial dose. Results are shown in Table 2.

Table 2: Use of vaccine against reproductive diseases (IBR, BVD and leptospirosis) in dams evaluated in the 2017/2018 and 2018/2019 breeding seasons.

Category	Vaccinated 2017/2018		Vaccinated 2018/2019	
	Yes	No	Yes	No
Nulliparous	169	62	270	70
Induced nulliparous	414	120	529	150
Primiparous	239	225	407	0
Multiparous	1177	2156	866	1898
Total	1999	2563	2072	2118

The diseases mentioned in Table 2 are highly representative at the national level. According to BEZERRA et al. (2012), IBR is a disease present throughout the Brazilian territory, appearing as a permanent and recurrent infection arising from stressful factors that lead to immunosuppression, such as pregnancy and calving.

Some serological surveys carried out in Brazil revealed a high frequency of animals and herds positive for IBR, with prevalence rates ranging from 21.1% to 82.7% (ALFIERI, 2001; AONO, 2012; ROCHA et al., 2001).

Bovine viral diarrhea is also an important disease that causes reproductive problems within Brazilian herds. It is associated with temporary infertility; embryonic

mortality; fetal mummification; malformation; stillbirth; birth of weak calves and/or calves with body weight below the average of the breed; pregnancy losses; and reduced herd fertility. Moreover, the incidence of dams positive for BVD can result in the production of persistently infected (PI) calves, which contributes to the maintenance and permanence of the disease in the herd (BROCK et al., 2005; LUNARDI et al., 2008).

In their survey, SAMARA et al. (2004) found a prevalence of 57.5% of BVD in the southern regions of the state of Minas Gerais and 56.5% in the northeast of the state of São Paulo, Brazil. Additionally, at least one reactive animal was found in all the evaluated herds. This disease is directly related to the age group, with older animals being at a greater risk of infection by BVD; that is, the

animal category in full reproductive activity is the most susceptible to infection and therefore requires greater health-related care (DEZEN et al., 2013).

In addition to being an extremely important zoonosis, leptospirosis is widespread and occurs in tropical, subtropical and temperate regions (FERREIRA; SOUSA; CASTRO, 2017). This disease is synonymous with damage to the production chain due to its impacts on reproduction, such as abortions and infertility, as well as reduced milk and meat production (FAINE et al., 1999). In a study led by FERREIRA; SOUSA; CASTRO (2017) in the state of Piauí, Brazil, the authors detected a prevalence of 34.5% positivity, 95.1% of which in dams. In addition, on all the evaluated farms, at least one positive animal was found in the herd.

Besides their negative impact on the production indices of the herd, some of the diseases that affect cattle also compromise human health, as many are classified as zoonoses, e.g. brucellosis and leptospirosis. These are considered occupational diseases, since professionals and collaborators involved with the management of animals are the most susceptible to infection, an aspect that reinforces the need for control and prevention (FERREIRA; SOUSA; CASTRO, 2017).

The indication and practice of vaccination against IBR, BVD and leptospirosis varies according to regional epidemiology and the health status of each herd. In recommendations of the schedule established by FRIAS et al. (2017), vaccination against these diseases can be administered from the maternal period (3 to 5 months of age), with a booster dose given after 21 to 30 days.

Booster doses of the IBR and BVD vaccines should be applied annually, whereas the booster dose of

leptospirosis is indicated at every every six months or even quarterly, which varies according to the assessment made by the responsible veterinarian regarding the incidence and serotypes prevalent in the region and on the farm. In addition, these vaccines must be administered 30 days before the beginning of the breeding season (FRIAS et al., 2017). In their study, AONO (2012) stated that dams vaccinated before the establishment of the FTAI protocol had better pregnancy rates than those immunized on day zero (D0).

At 30 days into the vaccine protocol, the dams evaluated in this experiment were exposed to the FTAI protocol, which was carried out as follows:

D0: Progesterone implant insertion + 2.0 mL estradiol benzoate;

D7: 1.5 mL prostaglandin;

D9: Progesterone implant removal + 0.3 mL estradiol cypionate + 1.5 mL equine chorionic gonadotropin (eCG);

D11: Artificial insemination.

On the first day of the FTAI protocol, the cows were evaluated for BCS. The classification was done using the scale of 1 to 5 described by JAUME; MORAES (2002), where score 1 was assigned to the lean, emaciated, cachectic, fatless cow which had lost a large part of its muscle mass. Score 2, cow with bones of the spine, ribs and hips visible and with little meat cover; narrow hindquarter. Score 3, cow with muscle mass on the ribs, spine and hindquarters, though with bones prominent; presence of a recession on each side of the tail insertion. Score 4, cow with good muscle cover on the ribs, spine and hindquarters; bones practically not visible; meat-filled tail insertion. Score 5, the fat cow: bone structure totally covered by meat and fat. The BCS data of the dams are described in Table 3.

Table 3: Body Condition Score (BCS) of dams evaluated in the 2017/2018 and 2018/2019 breeding seasons, according to the animal category.

Animal category	BCS 2017/2018				BCS 2018/2019			
	2	2.5	3	3.5	2	2.5	3	3.5
Nulliparous	0	0	0	231	0	0	294	46
Induced nulliparous	0	0	120	414	0	0	326	353
Primiparous	140	85	239	0	0	171	82	154
Multiparous	70	1335	1769	159	0	1036	884	844
Total	210	1420	2128	804	0	1207	1586	1397

In cattle, BCS is directly related to success in the reproductive activity of the dams. Therefore, nutritional management and the visual assessment of BCS are extremely important, since the ability of a cow to return to cyclicity is closely linked to its nutritional status. In this way, meeting these requirements and monitoring BCS ensures that these animals will maintain their reproductive functions, resulting in better pregnancy rates (TORRES; TINEO; RAIDAN, 2015).

The pre- and postpartum periods are the times of greatest nutritional challenge for dams, if we consider that, in addition to maintaining themselves, females need

to mobilize their energy reserves for fetal development and milk production. For this reason, their BCS must be maintained throughout these different production and reproduction phases. Thus, for maximum financial return to be attained with the activity, the cow must produce one calf per year. In this sense, nutritional supply and the monitoring of BCS are fundamental for the return to cyclicity (SANTOS et al., 2009).

In organizing the breeding season of their farm, producers should preferably select dams with a BCS above 2.5 (JAUME; MORAES, 2002), that wean good products and that are able to maintain good conditions

or recover easily in the postpartum period until weaning (ROSA et al., 2011). FERREIRA et al. (2013) stated that dams with a BCS greater than 2 are already able to maintain cyclical activity, considering a body condition score scale of 1 to 5.

Pregnancy diagnosis by ultrasound was carried out after 40 days of insemination. Results of pregnancy rate in relation to BCS are described in Table 4.

Table 4: Result of pregnancy diagnosis performed 40 days after artificial insemination according to BCS in dams evaluated in the 2017/2018 and 2018/2019 breeding seasons

Animal category	Pregnancy rate 2017/2018				Pregnancy rate 2018/2019			
	BCS 2	BCS 2.5	BCS 3	BCS 3.5	BCS 2	BCS 2.5	BCS 3	BCS 3.5
Nulliparous	-	-	-	58%	-	-	46%	-
Induced nulliparous	-	-	40%	55%	-	-	50%	53%
Primiparous	41%	44.5%	61%	-	-	57%	62%	71%
Multiparous	50%	51.5%	57%	60%	-	51%	56%	59%

When working with the FTAI protocol, it is recommended that dams have a BCS between 3 and 4 (scale of 1 to 6) or above 2.5 (scale of 1 to 5), as used in this research. Animals within this range possibly have normal cyclicity and the minimum weight necessary to attain good conception rates (JAUME; MORAES, 2002; TORRES et al., 2015).

In the present study, BCS values were related to pregnancy rates for each animal category. Primiparous was the category that most demonstrated the effect of BCS on pregnancy rate. Cows in this category with BCS 3.5 had a 30% higher pregnancy rate than those with BCS 2.

Among the nulliparous cows, better pregnancy rates were found in those with BCS 3.5 (58%) as compared with those with BCS 3 (46%). The same was found for

the induced nulliparous cows, whose pregnancy rate was 9% higher, on average, in the group with BCS 3.5 vs. BCS 3. Multiparous cows also had a 9% higher more rate when their BCS was 3.5 as compared with the group with BCS 2.

TORRES et al. (2015) reported that animals with a BCS higher than 3 have better pregnancy rates, and that a 0.5-unit gain in BCS increases the chances of conception. The current results corroborate this description, since a 0.5-unit increase in BCS unit resulted in improved pregnancy rates, and higher pregnancy rates were found in dams with a minimum BCS of 3.

FERREIRA et al. (2013) confirmed that females with a poor body condition ($BCS \geq 2.0 \leq 2.5$) have lower pregnancy rates than cows in better condition ($BCS \geq 3 \leq 4$) when subjected to FTAI, similarly to the present data.

Table 5 - Result of pregnancy diagnosis performed 40 days after artificial insemination according to the status of vaccination against IBR, BVD and leptospirosis in dams evaluated in the 2017/2018 and 2018/2019 breeding seasons

Information	Number of cows		Vaccination status	Pregnancy				Correlation*	
				Positive		Negative		p	Corr.
Type of animal	N	%		N	%	N	%		
Nulliparous	571	21.51	Not vaccinated	65	49.24	67	50.76	0.235	0.050
			Vaccinated	242	55.13	197	44.87		
Induced heifers	1213	45.69	Not vaccinated	125	46.30	145	53.70	0.000	0.065
			Vaccinated	510	54.08	433	45.92		
Primiparous	871	32.81	Not vaccinated	95	42.22	130	57.78	0.000	0.184
			Vaccinated	407	63.00	239	37.00		
Multiparous	6097	69.66	Not vaccinated	2027	50.00	2027	50.00	0.000	0.095
			Vaccinated	1226	60.01	817	39.99		
Total	8572	100	-	4697	53.67	4055	46.33	-	

* P value obtained after Spearman's correlation test was applied, considering $p < 0.005$.

Despite the improved results of pregnancy rate, a balance must be achieved when we consider BCS and

reproductive efficiency, since excessive fat deposition can also result in reproductive problems. Among the

obstacles found, there is a greater probability of dystocia, abortion and deficient lactation (FUCK et al., 2000). Results of pregnancy diagnosis in relation to the use of vaccines against reproductive diseases are described in Table 5.

Table 5 shows the increase in pregnancy rate in all analyzed categories, where the primiparous cows stood out with a 21% increase in conception when they were vaccinated. Likewise, the vaccinated multiparae exhibited a 10% higher pregnancy rate than their non-vaccinated counterparts. Dams with a more advanced age, in greater contact with other animals in the herd, and which actively participate in the breeding season are more prone to developing reproductive problems, which may explain the difference in pregnancy rate between the vaccinated multiparae and primiparae and their non-vaccinated counterparts (DEZEN et al., 2013).

When the reproductive vaccine was used in the nulliparous cows, their conception rate increased by 5.9%, on average. This improvement in pregnancy rate was not significant between the vaccinated and non-vaccinated animals. Nonetheless, for the producer, any increase in pregnancy rate is advantageous, since he or she will have a higher number of calves born, which will increase the profit of the activity.

Furthermore, the immunity boost provided by the vaccine to younger animals is an extremely important effect, as these animals have just entered reproductive life and undergo several challenges within the physiological and structural development process. In addition, they are exposed to stressful factors due to the first contact with the FTAI management to which they are subjected (CASTRO et al., 2008).

In the induced nulliparae, the increase was 7.8%. This significant increase can be attributed to the use of hormonal protocols to induce reproduction, along with the use of vaccines that improve the immunity of these animals.

Other studies corroborate the current findings regarding improved conception in dams vaccinated against reproductive diseases. AONO (2012) observed a 5% increase in pregnancy rate in vaccinated females. Similarly, FERREIRA et al. (2011) reported a 11.1% increase in pregnancy rate.

Despite the improved conception rates of the dams, regardless of the category, thorough knowledge of the herd and its productivity conditions as well as a regional epidemiological study are essential before vaccines against reproductive diseases are established or indicated, since this must be done according to the occurrence and prevalence of the infection in the region. In this way, the efficiency of vaccinations and, consequently, their cost-benefit ratio, can be improved, optimizing results.

CONCLUSIONS

Body condition score directly influences the reproductive efficiency of cows, and its observation helps in attaining better results. It is thus essential to control the pre- and postpartum BCS, since the ability of females to re-conceive is closely linked to their nutritional status. Therefore, good management of BCS can help to reduce the calving interval and allows dams to produce one calf per year.

The use of vaccines against reproductive diseases should be based on technical knowledge of the health status of herds. In addition, the epidemiological and performance data of each farm should be evaluated, but always considering its particularities, such as investment availability; region where it is situated; herd profile; and the main points to be corrected and improved, considering that success in the activity depends basically on the balance between sanitary, nutritional, reproductive and genetic management. Thus, taking all the previous points into account, the introduction of the vaccine protocol is a consistent and precise measure. It should however, be established in accordance with the real needs of each herd so that the cost-benefit for the producer can be improved, making it an important sanitary alternative that serves as a tool to address obstacles in the reproductive cycle within the herd.

When the vaccination system against reproductive diseases is applied to the farm, there is a tendency for herd production indices as well as the productivity and profitability of the operation to improve, since pregnancy losses and abortions are reduced and cow fertility increased. Altogether, these effects ultimately increase the farmer's efficiency in obtaining the livestock raw material—the calf.

REFERENCES

- ASSOCIAÇÃO BRASILEIRA DAS INDUSTRIAS EXPORTADORAS DE CARNES. ABIEC. Perfil da pecuária no Brasil. 2019. Disponível em: <<http://www.abiec.com.br/Sumario2019.aspx>>. Acesso em 10 out. 2019.
- AONO, F. H. S. Incidência de perdas gestacionais e efeito da vacinação contra doenças da reprodução nas taxas de prenhez em vacas de corte submetidas à inseminação artificial em tempo fixo. 2012. 90 f. Dissertação (Mestrado) - Faculdade de Medicina Veterinária e Zootecnia, Universidade Estadual Paulista, Botucatu, 2012.
- CASTRO, V. et al. Soroprelência da leptospirose em fêmeas bovinas em idade reprodutiva no estado de São Paulo, Brasil. *Arq. Inst. Biol.*, São Paulo, v.75, n.1, p.3-11, jan./mar., 2008.
- DEL FAVA, C.; PITUCO, E. M.; GENOVEZ, M. E. Diagnóstico diferencial de doenças da reprodução em bovinos: Experiência do Instituto Biológico. *Biológico*, v. 69, n. 2, p. 73-79, 2007.
- DEZEN. S. et al. Perfil da infecção pelo vírus da diarreia viral bovina (BVDV) em um rebanho bovino leiteiro de alta produção e com programa de vacinação contra o BVDV: *Pesq. Vet. Bras.* 33(2):141-147, fevereiro 2013.
- DEL FAVA. C. Índices reprodutivos e características de desempenho em bovinos de corte infectados e não infectados pelo Herpesvírus bovino tipo 1 (HVB-1). 2001. 127 f. Tese (Doutorado em Clínica Veterinária) -

Faculdade de Medicina Veterinária e Zootecnia, Universidade de São Paulo, São Paulo, 2002.

FERREIRA. N. et al. Impacto da condição corporal sobre a taxa de prenhez de vacas da raça nelore sob regime de pasto em programa de inseminação artificial em tempo fixo (iatf) Semina: Ciências Agrárias, vol. 34, núm. 4, julio-agosto, 2013, pp. 1861-1868 Universidade Estadual de Londrina Londrina, Brasil

FERREIRA. S. B. et al. Análise soropidemiológica e fatores de risco associados à *Leptospira* spp. em bovinos no estado do Piauí. *Acta Scientiae Veterinariae*. Porto Alegre, vol. 45, p. 1-11, out. 2017.

FERREIRA. R. M. et al. [Vaccination against IBR, BVD (Bioabortogen H®) and leptospirosis (Bioleptogen®) may increase the reproductive rates of beef cows]. *Hora Vet*, 2011; 184:19-22.

FRIAS. D. F. R. et al. Calendário de Manejos sanitário, Reprodutivo e Zootécnico. 2017. Disponível em: <<https://cloud.cnpgc.embrapa.br/cmrsz2017/files/2018/02/Calendar-io-CMRSZ-Versao-2018-final.pdf>>. Acesso em: 15 Jun. 2019.

GOMES, R. C.; FEIJÓ, G. L. D.; CHIARI, L. Evolução e qualidade da pecuária brasileira. 2017. Campo Grande. 4 p. Nota Técnica.

JUNQUEIRA, J. R. C.; ALFIERI, A. A. Falhas da reprodução na pecuária de corte com ênfase para causa infecciosas. *Semina: Ciências Agrárias*, v. 27, n. 2, p.289-298, 2006.

ROSA, A. N.; SILVA, L. O. C.; THIAGO, L. R. L. S. Avaliação do escore da condição corporal em zebuínos, 2011. Disponível em <<http://genepplus.cnpgc.embrapa.br/upload/artigos/CondicaoCorporalZebuinos20052016.pdf>>. Acesso em 28 set 2018.

SAMARA, S. I.; DAIAS, F. C.; MOREIRA, S. P. G.; BUZINARO, M. G. Ocorrência da diarreia viral bovina nas regiões Sul do Estado de Minas Gerais e Nordeste do Estado de São Paulo. *Ars Veterinária*, Jaboticabal, v. 20, n. 1, p. 75-82, 2004.

TORRES, H.A.L., TINEO, J.S.A., RAIDAN, F.S.S., Influência do escore de condição corporal na probabilidade de prenhez em bovinos de corte. <i>Archivos de Zootecnia</i> [en línea]. 2015, 64(247), 255-259 [fecha de Consulta 21 de Octubre de 2019]. ISSN: 0004-0592. Disponible en: https://www.redalyc.org/articulo.oa?id=49541390008.