Study of some characteristics regarding the lambings of three French sheep breeds

Mihai M. Borzan, Clarisse Goëtghebeur, Anamaria Blaga Petrean, Anamaria I. Paștiu, Alexandra Tăbăran

Department of Animal Production and Food Safety, Faculty of Veterinary Medicine, University of Agricultural Sciences and Veterinary Medicine Cluj-Napoca, Cluj-Napoca, Cluj, Romania. Corresponding author: M. M. Borzan, mihai.borzan@usamvcluj.ro

Abstract. Sheep is a species known for its numeric productivity per lambing, producing regularly twins and triplets. Some breeds are more prone to produce a high number of lambs per litter, and it is an important factor of selection for the farmers. The discovery of genes of hyper ovulations has given another dimension to the selection of the reproductions. Our observational, descriptive, retrospective study, conducted over a period of 4 years (2019-2022) was conducted based on data provided by ROM selection – France, on twin births among three sheep breeds, namely Blanche du Massif Central (BMC), Grivette, Noire du Velay (NdV), recognized for increased prolificity, in order to assess the level of overall production, specific to the breed. To realize this, we worked with the ROM selection, which is an association that gathers the 6 rustic sheep breeds of the Massif Central and helps in the selection, reproduction, and promotion of those breeds. The most productive years and breeds are those in which twin lambs account for more than half of the total number of lambs. In connection with its mode of production, in our study, the Grivette breed achieved the largest number of lambs coming from a litter, with 2-6 lambs. During the study, it was observed that morinatality had a downward trend in all three races studied. Twin litters are in all cases the main type of litter.
Key Words: breed, litter, lamb, overall production, ram.

Introduction. Sheep is a species which has been known for a long time for it tendency to produce litters of two lambs, sometimes even three. This characteristic is very interesting in term of rentability and overall production for the farmers. By consequence farmers are looking for this characteristic and it is one of the factors for the selection of reproduction (Department of Primary Industries and Regional Development 2020).

If it has already been proved that the prolificity of sheep is influenced by several environmental factors, in the 80's, several genes with major effect on the ovulation rate have been discovered. Since then, they are in analysis in different sheep populations, and, if some are already well described, others are still unknown. Those genes have been identified in the population of the 3 breeds we study, but the breeds are still at very different levels of analyses (McNatty et al 2005).

Those genes can also explain the appearance of litters of 4, 5 and 6 lambs that are not wanted. We chose to study three breeds, namely Blanche du Massif Central (BMC), Grivette and Noire du Velay (NdV), due to the different litter sizes in sheep, their repartition, and their impact on the overall production of the farm.

To realize this study, we worked with the ROM Selection that selects the genitors from its breeds, making them some of the most productive French breeds (https://www.races-ovines-des-massifs.com/fr/races-ovines-des-massifs/rassemble-nos-races/grande-souplesse-utilisation.php). They try to make this selection reasonable in number of lambs per litter, and they also select their animals that reproduce on physical characteristics. If there is low mortinatality, they have a high numeric production and by consequence, they try to keep the number of lambs per litter around 2 to 3. In its selection work, the ROM Selection registers data about every lamb born and its parents (https://www.races-ovines-des-massifs.com/fr/races-ovines-des-massifs/organisme-selection.php).

This study had several objectives. The first objective was to determine the tendency of litter size repartition for each breed, per year, and how this repartition evolves along the years. The second objective was to evaluate, according to the repartition in percentage of the type of litters, which distribution is most productive. The third objective was to assess the evolution of the overall production and mortinatality – in link with the types of litters - along the years, per breed. Finally, we assessed the breeds between them, per year, in order to determine which is the most productive, if it is constant along the years, to link it with the repartition of the different litter types and with their breeding and reproductive mode.

Material and Method. Our observational, descriptive, retrospective study, conducted over a period of 4 years (2019-2022) was realized based on data provided by Races Ovines des Massifs (ROM) selection – France, on twin births among three sheep breeds, namely Blanche du Massif Central (BMC), Grivette and Noire du Velay (NdV), recognized for increased prolificity, in order to assess the level of overall production, specific to the breed.

The source of the data was represented by birth registers for each breed. The registers contained, among others, the number of lambs born, birth date, information about the parents, the birth date of their mother, how many siblings, the sex of the lambs, and whether some of the brothers were born dead.

The criteria for including rams in the research was productivity, namely the most productive rams for each breed, from which resulted many multiple lambs. All lambs (born alive or dead) resulting from mating of rams participating in the study with sheep of the corresponding breed were included in the study. Registered lambs which could not be reliably associated with a particular ram were excluded.

To carry out this study, the following were determined once the rams have been selected: the number of litters of 1, 2, 3, 4, 5 and 6 lambs produced by each ram; the total number of lambs born from each ram, with how many ewes it has been mated; the total number of lambs born in each type of litter; the number of lambs dead from litters of 1 to6 lambs; and the total number of lambs dead. This information tabulated by year, from 2019 to 2020.

We used the following calculation formulas:

The total number of lambs produced from each ram = number of 1 lamb litter + (2 x number 2 lambs litters) + (3 x number of 3 lambs litters) + (4 x number of 4 lambs litters) + (5 x number of 5 lambs litters) + (6 x number of 6 lambs litters)

Total number of ewes mated with each ram = number of 1 lamb litter + number 2 lambs litters + number of 3 lambs litters + number of 4 lambs litters + number of 5 lambs litters + number of 6 lambs litters

For the total number of rams we made the following calculations: how many litters of 1 to 6 lambs were produced, how many lambs were born per type of litters and in total, how many lambs were dead per type of litter and in total.

We also calculated the mortinatality (in percentage) per size of litter, according to the total amount of lambs for the according litter size, by the following calculation formula:

Mortinatality per litter size = (Dead lambs for one litter type x 100)/Total number of lambs for this litter type

We calculated the mortinatality per year, without looking at the repartition of the litters, to determine the general tendency of the mortinatality over those 4 years. We also correlated those numbers to the overall production estimations, to have a more accurate result and taking into account the dead lambs, using the following calculation formula:

Overall mortinatality = (total number of dead lambs x 100)/Total number of lambs born

We calculated the total number of lambs born per year from the rams studied with the following equation:

Total number of lambs produced = single litters + (2 x double litters) + (3 x triple litters) + (4 x quadruple litters) + (5 x quintuple litters) + (6 x sextuple litters)
We calculated the prolificacy, by the following calculation formula:

Prolificacy = percentage of single litters + (2 x percentage of double litters) + (3 x percentage of triple litters) + (4 x percentage of quadruple litters) + (5 x percentage of quintuple litters) + (6 x percentage of sextuple litters)

We also calculated the ram productivity in the studied period, for each breed, with the following formula:

Ram productivity = average of live lambs / ram's average

Results and Discussion. Analyzing the distribution of lambing and lambs born alive and dead according to litter size for the 3 breeds studied, the results are presented in Tables 1 to 3. In the BMC breed, the highest number of born lambs was registered in 2020, followed by 2021, 2019 and 2022 (Table 1).

Table 1

Distribution of lambing and lambs born alive and dead according to litter size for the Blanche du Massif Central breed

Blanche du Massif Central		Total	Lambs per litter					
			1	2	3	4	5	6
2019	Lambing	982	332	488	137	21	4	0
	Lambs born	1823	332	976	411	84	20	0
	Stillborn lambs	150	15	45	61	23	6	0
2020	Lambing	1127	471	506	131	19	0	0
	Lambs born	1952	471	1012	393	76	0	0
	Stillborn lambs	113	16	42	42	13	0	0
2021	Lambing	1098	400	567	119	10	2	0
	Lambs born	1941	400	1134	357	40	10	0
	Stillborn lambs	102	14	31	41	13	3	0
2022	Lambing	1030	385	520	108	16	1	0
	Lambs born	1818	385	1040	324	64	5	0
	Stillborn lambs	86	11	37	28	9	1	0

By analyzing the number of lambs born according to litter size in BMC, it was found that the highest number of lambs came from twin litters in 2021. The main type of litter is always twin litters. This makes sense based on the breeding cycle of the sheep and the selection that has been applied to the breeds over the years. Its percentages vary over the years.

Triplets lambs represent the largest number in 2019 for the BMC breed, the evolution being an annual decrease during the studied period. It is negative in terms of numerical productivity and, therefore, meat production for breeders, as fewer triplets mean smaller weight lambs. However, it is better in terms of stillbirth and individual performance. According to Larsen (2022), lambs born in litters of 3 are, in most cases, smaller and weaker compared to single or twin lambs, often need to be fed powder milk, sheep may not recognize all the lambs and there is an increased risk of dystocia. Therefore, they have a higher mortality rate, but this can be interesting from the point of view of overall production for farmers. It is up to the breeder and their goals to decide whether they want to aim the selection for a higher number of triplets or, conversely, limit their number.

Gestations with 5 lambs were the most numerically reduced lambing recorded in each year studied. 2020 did not record quintuple lambs, which is a positive aspect.

Breeders should try to limit the incidence for it because of the high mortality and lower development of the lambs. It is noteworthy that the BMC breed did not have lambings with 6 lambs in the four years studied. These would be high-risk lambs, with a high percentage of stillbirths. For the same reasons, the aim is to reduce the incidence of this type of litter. Stillborn lambs were recorded every year, the highest number being in 2019, of which two-fifths came from triplets born. BMC is the breed that presents values in the second rank in terms of the number of single lambs. For the rest of the litter types, they always show lower values than the other breeds included in our study. This can be explained by the fact that BMC does not produce systemically in the accelerated reproductive system, but sometimes it is used in this system.

For the Grivette breed (Table 2), the higher number of lambs born were registered in 2019, followed by 2021, 2020 and 2022.

Table 2

Distribution of lambing and lambs born alive and dead according to litter size for the Grivette breed

Grivette		Total	Lambs per litter					
			1	*2*	*3*	*4*	*5*	*6*
2019	Lambing	1758	474	901	331	44	6	2
	Lambs born	3487	474	1802	993	176	30	12
	Stillborn lambs	268	17	97	117	25	8	4
2020	Lambing	1528	316	823	337	45	6	1
	Lambs born	3189	316	1646	1011	180	30	6
	Stillborn lambs	284	9	98	133	30	14	0
2021	Lambing	1579	343	878	308	42	6	2
	Lambs born	3233	343	1756	924	168	30	12
	Stillborn lambs	284	8	105	112	39	16	4
2022	Lambing	659	162	337	128	29	3	0
	Lambs born	1351	162	674	384	116	15	0
	Stillborn lambs	134	7	43	52	21	11	0

By analyzing the number of lambs born according to litter size, it was found that the largest number of lambs came from twin litters in 2021. In 2020, Grivette was the only breed for which half of the female lambs were twins, just like in 2019. This distribution was maintained for the 4 years studied, with a different percentage of twin lambs every year, systematically over 50%. Having a good prolificacy and a low stillbirth rate, the twins obtained in this breed have increased chances of survival.

The highest number of stillborn lambs for Grivette was recorded in 2019, and they came from twin pregnancies. In the Grivette breed, during the studied period, a number of 5 pregnancies with 6 lambs were recorded. Grivette is the breed with the lowest mortinatality for triple and quadruple litters. Grivette was also the breed with the highest proportion of lambings, with 3, 4, 5, 6 lambs, during the studied period. This is a positive aspect for the breed's overall production, but as we have previously specified, these lambs also carry many other risks (Peter et al 2017). This can be partly explained by the fact that Grivette breed has been selected continuously in the purebred system towards an accelerated breeding system, producing more than 2 lambs per year.

For the NdV breed (Table 3), the maximum number of lambs born was recorded in 2019, and the lowest number in 2022. By analyzing the number of lambs born according to litter size, it was found that the largest number of lambs came from twin litters in 2019. The NdV breed produced the highest number of single lambs among the 3 breeds, with 42.81% of its total lambs being single. It is surprising to see that the percentage of twin lambs is almost equal to that of singles, being 42.96%. In general, these percentages are closer to what we find in Grivette and BMC breeds, which means that about half of the litters are twins. Even if they show some variation, the percentage of single lambs is high. In general, form the economic point of view, it is desired to obtain a maximum number of twin lambs, so this distribution of litter sizes for NdV breed is not optimal.

The percentage of triple lambs per gestation places the NdV breed second among the 3 breeds in each year of the study and for the entire period. However, there is an increased risk of mortinatality and mortality, which can cause a loss of numerical productivity and decreased meat production.

Females with quadruple litters were present annually, their number being between the quadruple lambing numbers of the Grivette and BMC breeds. This is a breed with lambings of 5 lambs annually, during the studied period, and is also between the Grivette and BMC breeds in terms of values. In the NdV breed, during the studied period, a pregnancy with 6 lambs was recorded. The highest number of dead newborn lambs was recorded in 2019, coming from twin and triple gestations.

NdV has 2 different breeding systems: an extensive system, in which fewer lambs are be produced per year and an accelerated breeding system, producing approximately 3 lambings in 2 years, which is considered intensive breeding.

Table 3

Distribution of lambing and lambs born alive and dead according to litter size for the Noire du Velay breed

Noire du Velay		Total	Lambs per litter					
			1	2	3	4	5	6
2019	Lambing	2016	863	866	235	47	5	0
	Lambs born	3513	863	1732	705	188	25	0
	Stillborn lambs	308	25	111	111	55	6	0
2020	Lambing	1589	595	749	193	46	5	1
	Lambs born	2887	595	1498	579	184	25	6
	Stillborn lambs	249	16	87	87	42	15	2
2021	Lambing	1588	651	740	162	29	6	0
	Lambs born	2763	651	1480	486	116	30	0
	Stillborn lambs	253	27	91	90	33	12	0
2022	Lambing	724	290	308	101	21	4	0
	Lambs born	1313	290	616	303	84	20	0
	Stillborn lambs	100	6	31	42	14	7	0

Throughout the studied period, in all 3 breeds, there was a decrease in the number of dead born lambs, more pronounced in the NdV breed in 2022. The BMC breed recorded the most constant decrease in the number of dead lambs at lambing during the studied period (Figure 1).
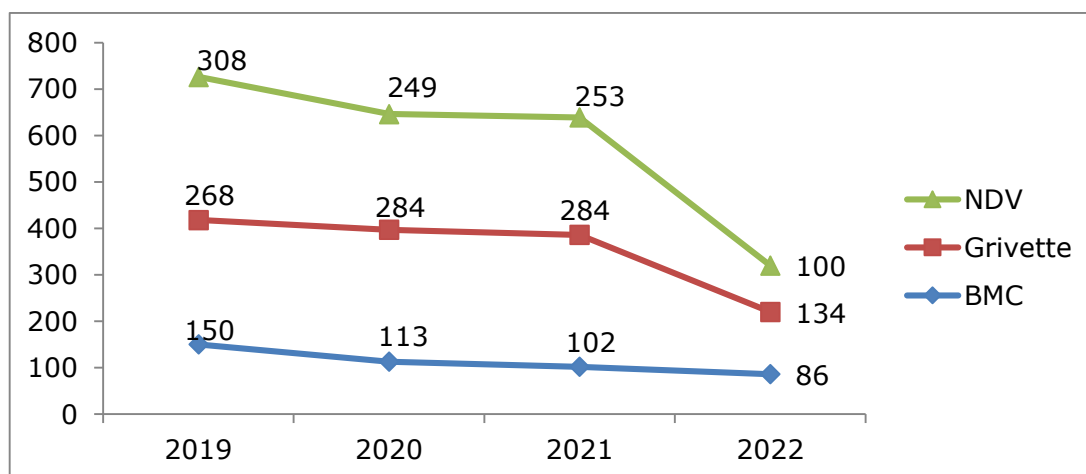

Figure 1. Distribution of stillborn lambs in Blanche du Massif Central (BMC), Grivette, Noire du Velay (NdV) breeds in 2019-2022.

During the entire studied period, the maximum number of lambs obtained in our study was recorded in the Grivette breed and the minimum number in the BMC breed. Twin gestations and triplets represented the majority of lambings in the Grivette breed, which generated a high number of lambs (Table 4). In the NdV breed, the mortinatality in litters of 4, 5 and 6 lambs recorded high values throughout the studied period (Table 4). The highest mortinatality rate was recorded in the litter of 5 lambs, regardless of the breed studied, which confirms the findings of Sales et al (2018).

Table 4

Distribution of lambing, lambs born alive and stillborn lambs according to litter size in the breeds/studied period

Breeds		Total period 2019-2022	Lambs per litter					
			1	2	3	4	5	6
Blanche du Massif Central	Lambing	4237	1588	2081	495	66	7	0
	Lambs born	7534	1588	4162	1485	264	35	0
	Stillborn lambs	451	56	155	172	58	10	0
	Mortinatality %	5.99	3.53	3.72	11.58	21.97	28.57	0
Grivette	Lambing	5524	1295	2939	1104	160	21	5
	Lambs born	11260	1295	5878	3312	640	105	30
	Stillborn lambs	970	41	343	414	115	49	8
	Mortinatality %	8.61	3.17	5.84	12.50	17.97	46.67	26.67
Noire du Velay	Lambing	5917	2399	2663	691	143	20	1
	Lambs born	10476	2399	5326	2073	572	100	6
	Stillborn lambs	910	74	320	330	144	40	2
	Mortinatality %	8.69	3.08	6.01	15.92	25.17	40.00	33.33

In the analysis of mortinatality between breeds, the first rank was occupied by NdV, followed by Grivette by a small margin and BMC (Table 4). Depending on the litter size, NdV had the highest stillbirth rate was recorded for 5 lambs (over two fifths of the lambs were dead), 6 lambs and 4 lambs, throughout the studied period. For Grivette, the maximum mortinatality was recorded in litters of 5 lambs, followed by 6 lambs, and for BMC, in litters of 5 and 4 lambs, respectively.

Analyzing the share of single and multiple gestations according to breeds and the studied period, we found that the NdV breed had the highest share, over two fifths, of pregnancies with a single lamb, while the Grivette breed had the lowest share among the 3 breeds analyzed. Over three quarters of gestations with multiple lambs were recorded in the Grivette breed (Figure 2).

During the entire period, the BMC breed had the lowest share of stillborn lambs, below 6%. For the other breeds included in the research, this share was also low, below 9% (Figure 3).

The highest value of prolificacy in the period 2019-2022 was recorded in the Grivette breed, followed by NDV and BMC (Table 5).
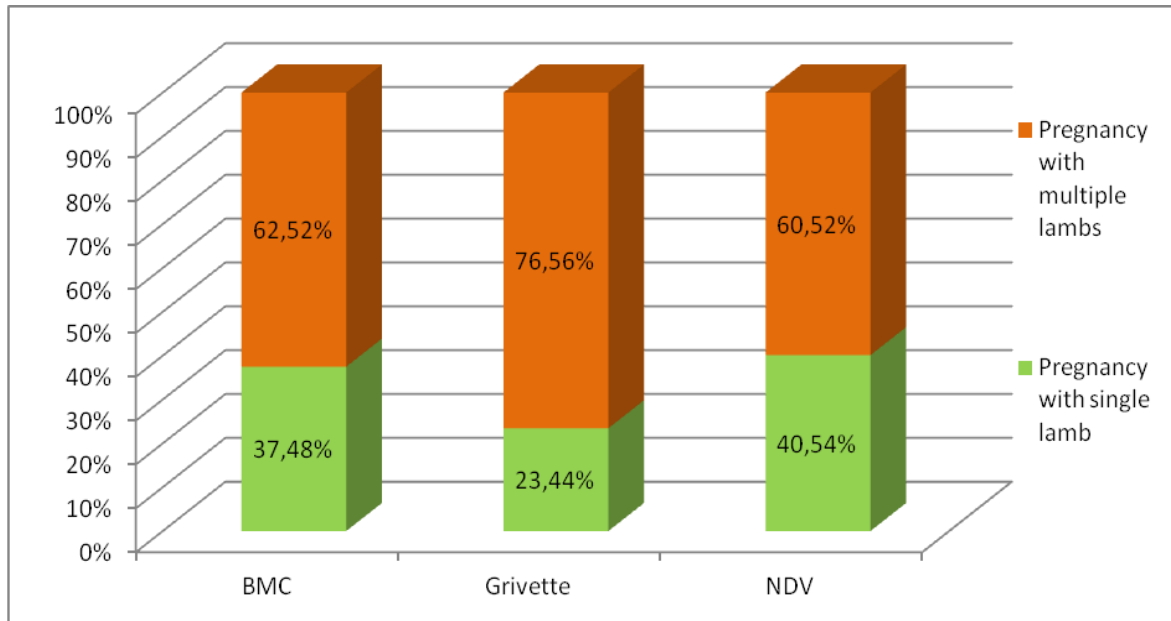
Figure 2. The share of single and multiple gestations according to breeds in the studied period; BMC - Blanche du Massif Central; NdV - Noire du Velay.
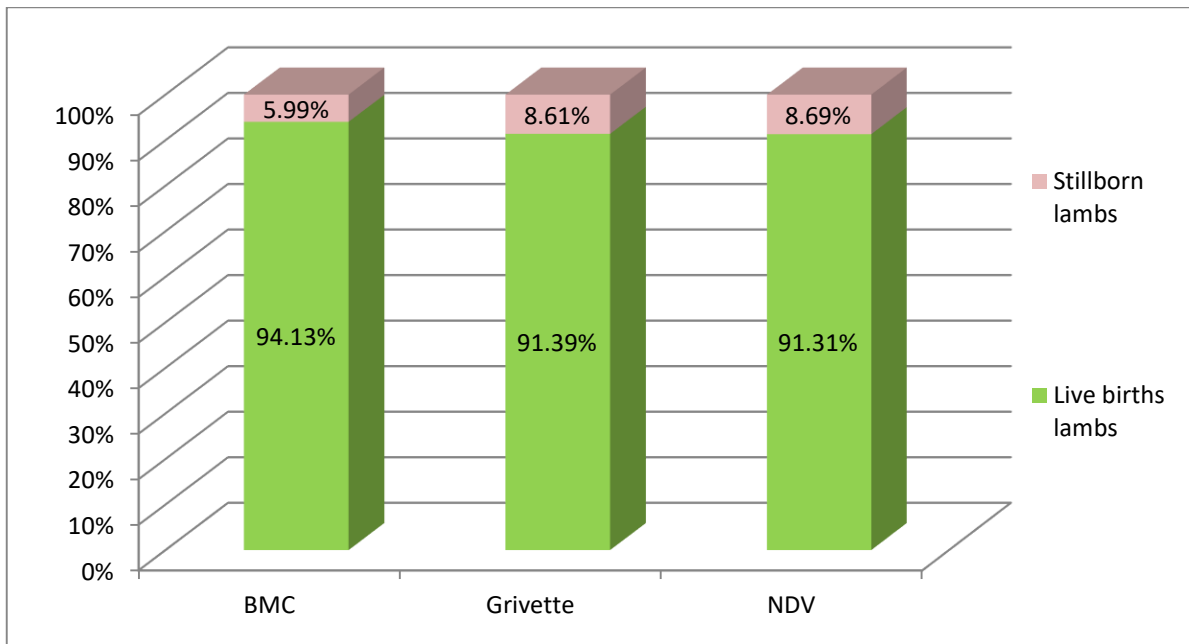

Figure 3. The share of live and stillbirths lambs by breed and the studied period; BMC - Blanche du Massif Central; NdV - Noire du Velay.

The share of lambs and prolificacy in 2019-2022 by breed and litter size

Breeds		Total period 2019-2022	Lambs per litter					
			1	2	3	4	5	6
Blanche du Massif Central	Lambs born	7534	1588	4162	1485	264	35	0
	% lambs born per litter		21.08	55.24	19.71	3.50	0.46	0.00
	Prolificacy	207.03						
Grivette	Lambs born	11260	1295	5878	3312	640	105	30
	% lambs born per litter		11.50	52.20	29.41	5.68	0.93	0.27
	Prolificacy	233.14						
Noire du Velay	Lambs born	10476	2399	5326	2073	572	100	6
	% lambs born per litter		22.90	50.84	19.79	5.46	0.95	0.06
	Prolificacy	210.90						

In our study, the highest productivity of rams was recorded in the Grivette breed, followed by the NdV breed, with BMC rams having the lowest productivity (Table 6).

The productivity of rams by breeds during the studied period

Breed		Ram	Sheep	Lamb
Blanche du Massif Central	2019	53	982	1823
	2020	56	1127	1952
	2021	52	1098	1941
	2022	51	1030	1818
	Average	53	1059.25	1883.5
	Ram productivity	35.54		
Grivette	2019	73	1758	3487
	2020	62	1528	3189
	2021	65	1579	3233
	2022	38	659	1351
	Average	59.5	1381	2815
	Ram productivity	47.31		
Noire du Velay	2019	60	2016	3513
	2020	60	1589	2887
	2021	60	1588	2763
	2022	53	724	1313
	Average	58.25	1479.25	2619
	Ram productivity	44.96		

ROM selection is an association that brings together the 6 rustic sheep breeds of the Massif Central area in France: Bizet, Grivette, Blanche du Massif Central, Rava, Noire du Velay and Limousine. It was created in 1993 by the breeders of the 6 breeds. In 2011, it included 200 breeders and 60000 sheep (https://www.races-montagnes.com/). The association has several objectives for breeds: defining breed characteristics, certifying the affinity of an animal to its breed, establishing selection objectives, coordinating selection, recording the genealogy and performance of animals, promoting breeds and gathering collective resources for each breed. As it has developed, the association has created new missions to meet the needs of its partners and members.

Individuals of these breeds are very well adapted to the territory in which they live, they are resistant to potential sanitary problems. They are kept indoors for 5 to 6 months in the winter, and in the summer, due to the sparse grass, it is generally difficult for the

sheep to cover all energy needs. They use their body reserves, consequently becoming thinner, but they are able return to initial body score condition and regain the weight they have lost (https://www.races-montagnes.com/).

BMC comes from Causses, being officially created in 1975. They have white wool. Adult ewes weigh between 60 and 80 kg, and males between 90 and 140 kg. The total population is estimated at 359000 sheep, mainly concentrated in Auvergne and Languedoc Roussillon (73% of the population) (https://www.races-ovines-des-massifs.com/fr/description-races/blanche-massif-central/blanche-massif-central-resume.php). It is considered the first breed of meat sheep in France. It is a very adaptable breed that lives perfectly in the dry open air areas of the south of the Massif Central, as well as in a more traditional herd breeding method in the more continental and mountainous areas of the Auvergne. On average, there are 400 ewes per flock, generally lambing in autumn or spring. Some farms practice an accelerated breeding system. It is generally reproduced in purebreedings. The main 2 selection objectives are maternal values and meat values.

The Grivette breed began to be selected in 1981, mainly on the basis of its milk production and prolificacy, and is now mainly developed in the Loire and Rhône departments. Females weigh around 65 kg and males around 100 kg, both sexes being hornless. The head and legs have brown and black spots and the wool is white. The population is estimated at 21000 animals in France. In the 1990s, the adoption of the two-step cross-breeding method allowed the breed to overcome its physical limitations, making it a valuable breed in the production of quality lambs outside the traditional season of reproduction. It has good mothering skills, good milk production and high prolificacy, allowing them to participate in accelerated breeding systems that produce more than 2 lambs per ewe per year (https://www.races-ovines-des-massifs.com/fr/description-races/grivette/givrette.php).

The NdV breeding association was created in 1931 and was named as such only in 1950 (https://www.agneau-noirduvelay.fr/race-agneau-noir-du-velay-43_fr.html). Currently, there are 22300 registered individuals of this breed in France, mainly in the Velay areas. The wool and skin are black, ewes weighing between 50 and 70 kg and rams between 80 and 110 kg, both sexes being hornless. They have very good mothering abilities, good milk production, and are easy to reproduce outside of the breeding season, which allows the breeder to raise vigorous lambs all year round. This breed is farmed in various systems depending on the geographical location. In the mid-mountain regions, intensive agricultural practices are used, allowing for an accelerated reproductive cycle of three lambings within two years. In southern regions, extensive grazing systems are favored, resulting in pasture-fed lambs. It is frequently crossed with rams from other breeds with better meat qualities to improve the conformation and growth rate of the lambs (https://www.agneau-noirduvelay.fr/race-agneau-noir-du-velay-43_fr.html).

The Grivette breed was the most productive breed in this study, its prolificacy being 233.14%, followed by the NdV with 210.9%, and finally the BMC, with 207.03%. The productivity of the Grivette breed can be partly explained by its mode of reproduction and exploitation, and partly its genetics. It is a breed that can be reproduced out of season. There are several ways of breeding it, from the production of 1 litter per year, to an accelerated reproduction system producing 3 litters in 2 years. This high productivity per litter is mainly explained by the presence in the breed of the gene BMP 15, presented on the chromosome X, which is a gene known to induce hyper ovulation (Chantepie et al 2020).

The BMC breed presents similarities with the Grivette and NdV, but also important differences in overall production. Compared with the Grivette breed, one major difference is that 87% of the ewes only produce one litter per year. 17% of the BMC ewes lamb two times per year and, among them, 36% have received treatment to synchronize their estruses. 13% of the lambings have been produced using artificial insemination and estrus synchronization. An interesting fact is that the prolificity increases with about 10% in spring and autumn, additionally it rises until the 7th year of the ewe's life. A mutation of a hyper ovulation gene has been identified in some BMC ewes, but it has not been sufficiently studied (Chantepie et al 2020).

The NdV is a breed that is reproducing naturally out of the breeding season, with 3 main periods of lambing, similar to those of the BMC breed, and with the rest of the lambings distributed along the year. In average, it lambs 3 times in 2 years. However, its lower overall production might be explained by the systems of productions used. In medium mountainous regions, it is bred in intensive farming, so with accelerated reproduction, producing 3 lambings in 2 years. In the southern regions, it is reared in a grazing system, less productive. However, some individuals of the breed also possess a hyper ovulation gene, which is still in study (Chantepie et al 2020). As for the BMC, it will be something to consider in the following years for the selection and reproduction of the breed.

There are several solutions that exist in order to increase the numeric productivity (number of lambs): the flushing method, the male effect method and the method to advance the age of the first gestation. This last method is used in the NdV breed, where the ewes are sexually premature. To increase the numeric productivity of the breeds, pharmacological methods are also available, such as hormonal estrous synchronization, which is used in BMC. It uses intravaginal sponges with progestogen and intravaginal devices with natural progesterone such as CIDR (controlled internal drug release) (Wheaton et al 1993). Prostaglandins and its derivates can also be used, administered intramuscularly: PGF2 alpha, cloprostenol, luprostiol. The intramuscular administration is not always optimal, as it requires many handling processes from the farmers (Noakes et al 2001; Noakes et al 2019).

Excepting BMC, the other studied breeds are mated naturally. The introduction of artificial insemination (AI) for these breeds could be interesting because the main advantage of the AI is the full control in the selection of animals for mating (Larsen 2022). However, it is logistically complicated if farms are not correctly equipped. It requires handling the ewes, and the rams to collect sperm, which furthermore must be adequately conserved, transported and inseminated.

The decrease of the mortinatality is also a very important way of increasing the numeric productivity. There are several factors that need to be controlled. A good management in the farm for critical periods will increase the productivity (Larsen 2022). Other factors are supervising the lambings and the postpartum period, the administration of colostrum in lambs in the first hours of life, the housing should be appropriate, the adequate management of flock immunity (Larsen 2022). The training of the workers on all these subjects is essential. Having homogenous lots will affect the mortinatality during lactation. Extensive breeding presents more risks as it has less impact on the condition of living, but it produces more resistant lambs. The mortinatality will always be higher when there are more than three lambs per litter. Apart than selection, it is not possible to change the average number of lambs per litter.

Conclusions. The type of research chosen (observational, descriptive, retrospective) does not allow the extrapolation of the data obtained to all sheep breeders of the BMC, Grivette and NdV breeds. In general, the most productive years and breed are those in which twin lambs represent more than half of the total number of lambs. A higher number of litters with multiple lambs means more beneficial results for breeders. In the current study, the general trend for stillbirth was downward in all three breeds studied. Rams from the Grivette breed recorded the highest productivity during the entire studied period, followed by NdV, and the lowest was in BMC. In our study, the main type of litter was twin litters in each year and in each breed, which can be related to good selection. According to these results, we can conclude that it will be very important to monitor the birth of lambs in the coming years for each breed, in order to estimate the general production trends and react adequately to the market demand, by selections and by optimizing the growing conditions. For adequate results in sheep breeding, in addition to genetic and breeding selection, monitoring external factors (such as the optimal breeding system), immunity and nutrition, it is also important to focus on work and good collaboration between breeders, veterinarians, selectors, workers, as well as on the education of all persons who are involved and influence the rearing of sheep. This study could be considered a model of evaluation that can be extended in the future to other breeds and for other lambing

parameters, to assess the breed's productivity, and to determine the economical factors that can change the criteria of selection for the breeding programs.

Conflict of Interest. The authors declare that there is no conflict of interest.

References

Chantepie L., Bodin L., Sarry J., Woloszyn F., Plisson-Petit F., Ruesche J., Drouilhet L., Fabre S., 2020 Genome-wide identification of a regulatory mutation in BMP15 controlling prolificacy in sheep. Frontiers in Genetics 11:585.

McNatty K. P., Galloway S. M., Wilson T., Smith P., Hudson N. L., O'Connell A., Bibby A. H., Health D. A., Davis G. H., Hanrahan J. P., Juengel J. L., 2005 Physiological effects of major genes affecting ovulation rate in sheep. Genetics, Selection, Evolution 37(Suppl 1):S25-38.

Noakes D., Parkinson T., England G., 2019 Veterinary reproduction and obstetrics. 10th Edition. Elsevier, pp. 510-521.

Noakes D., Parkinson T., England G., Arthur G. H., 2001 Arthur's veterinary reproduction and obstetrics. 8th Edition. Elsevier, 868 p.

Peter R. F., Gugusheff J., Wooldridge A. L., Gatford K. L., Muhlhauser B. S., 2017 Placental restriction in multi-fetal pregnancies and between-twin differences in size at birth alter neonatal feeding behaviour in the sheep. Journal of Developmental Origins of Health and Disease 8(3):357-369.

Sales F., Peralta O. S., Narbona E., McCoard S., De los Reyes M., Gonzalez–Bulnes A., Parraguez V. H., 2018 Hypoxia and oxidative stress are associated with reduced fetal growth in twin and undernourished sheep pregnancies. Animals 8(11):217.

Wheaton J. E., Carlson K. M., Windels H. F., Johnston L. J., 1993 CIDR: A new progesterone-releasing intravaginal device for induction of estrus and cycle control in sheep and goats. Animal Reproduction Science 33(1-4):127-141.

*** Department of Primary Industries and Regional Development, 2020 Reproduction potential and marking rates of the WA sheep flock. Government of Western Australia. Available at: https://www.agric.wa.gov.au/management-reproduction/reproduction-potential-and-marking-rates-wa-sheep-flock

*** https://www.agneau-noirduvelay.fr/race-agneau-noir-du-velay-43_fr.html

*** https://www.races-montagnes.com/

*** https://www.races-ovines-des-massifs.com/fr/description-races/blanche-massif-central/blanche-massif-central-resume.php

*** https://www.races-ovines-des-massifs.com/fr/description-races/grivette/givrette.php

*** https://www.races-ovines-des-massifs.com/fr/races-ovines-des-massifs/rassemble-nos-races/grande-souplesse-utilisation.php

*** https://www.races-ovines-des-massifs.com/fr/races-ovines-des-massifs/organisme-selection.php.

*** Larsen J. W. A., 2022 Measuring reproductive performance of sheep. Available at: https://www.msdvetmanual.com/management-and-nutrition/management-of-reproduction-sheep/measuring-reproductive-performance-of-sheep

Authors:
Mihai Marian Borzan, Department of Animal Production and Food Safety, Faculty of Veterinary Medicine, University of Agricultural Sciences and Veterinary Medicine Cluj-Napoca, Calea Manastur 3-5, 400372 Cluj-Napoca, Romania, e-mail: mihai.borzan@usamvcluj.ro
Clarisse Goëtghebeur, Department of Animal Production and Food Safety, Faculty of Veterinary Medicine, University of Agricultural Sciences and Veterinary Medicine Cluj-Napoca, Calea Manastur 3-5, 400372 Cluj-Napoca, Romania, e-mail: cla.goet@gmail.com
Anamaria Blaga Petrean, Department of Animal Production and Food Safety, Faculty of Veterinary Medicine, University of Agricultural Sciences and Veterinary Medicine Cluj-Napoca, Calea Manastur 3-5, 400372 Cluj-Napoca, Romania, e-mail: anamaria.petrean@usamvcluj.ro
Anamaria Ioana Paștiu, Department of Animal Production and Food Safety, Faculty of Veterinary Medicine, University of Agricultural Sciences and Veterinary Medicine Cluj-Napoca, Calea Manastur 3-5, 400372 Cluj-Napoca, Romania, e-mail: oana.pastiu@usamvcluj.ro
Alexandra Tăbăran, Department of Animal Production and Food Safety, Faculty of Veterinary Medicine, University of Agricultural Sciences and Veterinary Medicine Cluj-Napoca, Calea Manastur 3-5, 400372 Cluj-Napoca, Romania, e-mail: alexandra.lapusan@usamvcluj.ro