

LIMING WITH SLURRY ENRICHED WITH CALCIUM CARBONATE USED LIKE BEDDING MATERIAL IN A DAIRY COWS STALL

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ABSTRACT

The calcium carbonate used like bedding material in a ecological Galician dairy farm “Arqueixal”, increased the calcium concentration in slurry from 1,9 % on dry-matter basis (DM) in the year 1998, until to 7,1% in the year 2004, and therefore improved its liming value. The effect of this calcium enriched slurry on the soil pH is studied in 29 plots during three years. After of 3 years of slurry enriched application on Arqueixal farm plots, the pH arised from 6,38 to 6,54 (weighted median of 29 plots). 15t of calcium carbonate was used by year in the stall, for 30 dairy cows (0,5t of calcium carbonate by cow and year). Although pH slurry don't varied (7,4), It will be desirable to asses if exit more losses of NH₃ because the addition of an alkaline product could elevate the pH and therefore the losses in alleys, slurry pits or in land application.

Keywords: *inorganic bedding, lime.*

INTRODUCTION

The calcium carbonate used like bedding material in dairy cows stalls is useful to prevent mastitis an other bacterial cow diseases. Tradicionaly in Galicia was used superphosphate like disinfectant of bedding material. The dairy farm intensification, with a high feeding stuffs consumption, and high stocking rates lead to a high level of phosphorus in soils from slurry application, therefore it seems more advisable utilize another type of disinfectant that don't increase the phosphorus concentration of slurry.

The use of lime, in substitution of superphosphate like disinfectant, is a cheap solution and it may be a way of avoid the increase the phosphorus in soil, and at the same time, a way to reduce soil acidity. A good management in dairy grazing systems must to promote the white clover in the meadows (Piñeiro et al, 2002), and white clover needs a soil pH above 5,6 to grow without restrictions (Ruseell, 1988).

Galicia is a humid region with sufficient rainfall to leach out much of the base cations like calcium, leaving the exchange complex dominated by Al³⁺ and H⁺ ions, it is the principal cause of soil acidity. Soil acidity is commonly correted addind liming materials to the soil, mainly carbonates.

The utilization of carbonates, like bedding material, contribute to enriched the calcium content of manure and therefore increase its liming value.

On the other hand it is possible to reduce soil compactation avoiding the traffic of liming machinery and also reduce cost of liming application.

MATERIAL AND METHODS

Arqueixal is a commercial ecological Galician dairy farm that is collaborating with CIAM from 1995 in several research projects. It is located in Lugo province (Spain), at 550 m of altitude, with an annual rainfall of 1200 mm. Soil texture is sandy loam, with a medium content of 68, 21, and 11% of sand silt and clay respectively.

The farm has 30 dairy cows that spend out of stalls an average annual time of 8h day⁻¹ grazing. The total area of the farm is 20 ha. In the year 1999 began to use calcium carbonate like bedding material in cubicles, in the ratio of 15 t by year, (0,5 t cow⁻¹ year⁻¹). The dirtied or kicked lime goes to the slurry pit increasing its liming value.

Slurry was sampled two times by year from 1998 to 2004. Soil sampling, at 10 cm of depth, were taken in december during the last 3 years in 29 plots of the farm. The plots are fertilizer only with slurry and manure.

RESULTS AND DISCUSSION

The Ca concentration in Arqueixal slurry, was increased from 1.9% on dry-matter basis (DM) in the year 1998, until to 7,1% in the year 2004, meanwhile pH don't varied (table 1). The medium consumption by cow and day was 1.37 kg of calcium carbonate.

Table 1. Evolution of pH and calcium concentration of slurry in Arqueixal farm

year	1998	1999	2000	2001	2002	2004
pH water 1:1	7.4	7.3	7.3	7.4	7.2	7.4
Ca % on dry-matter basis (DM)	1.9	6.0	7.4	5.0	5	7.1

In another nine dairy farms, that used calcium carbonate like bedding material, the calcium increment was similar, from 2,7 to 7,4 % DM, and the pH was increased very lightly, from 7,3 to 7,4, before and after respectively for an average consumption by cow and day of 3,3 kg of calcium carbonate (Lema, 2001) (table 2).

Table 2: pH and calcium average concentration in slurry analysis of 9 dairy farms, before and after the utilization of calcium carbonate in cubicles. (Lema, G. 2001, data not published).

	Before the use of carbonate in cubicles	After the use of carbonate in cubicles
pH (water)	7.3	7.4
Ca % DM	2.7	7.4

Soil pH evolution in Arqueixal farm

The Weighted Average soil pH of the 29 plots of Arqueixal farm, was increased of 6,38 to 6,54 from 2001 to 2003, (table 3), it means that the bedding material could have an extra value like liming, saving the labour and money of liming, however it be desirable to assess if exit more losses of NH₃ because it is added an alkaline product that could elevate the pH and therefore the losses in alleys, slurry pit or in land application.

Table 3: soil pH evolution in 29 plots of Arqueixal farm.

year	Soil pH (water) evolution in Arqueixal farm plots		
	max	min	Weighted Average (29 plots)
2001	6.66	5.96	6.38
2003	6.98	5.98	6.54

The relationship between the annual consumption of calcium carbonate in cubicles and the 20 ha of total area fertilized with slurry, imply to apply a dose of 750 kg ha⁻¹ year⁻¹ of calcium carbonate, that could be an excessive dose if we compare with about 2000 kg every five years (400 kg⁻¹.year⁻¹), that is the usual Galician liming recommendation to keep the grassland soil pH. If it is supposed that 400 kg by ha and year is the correct dose to maintain the soil pH, it should be used no more than 8t of calcium carbonate in cubicles by year in Arqueixal farm, equivalents to 0,7 kg by cow and day.

Another possibility to reduce the slurry calcium content will be to mix the calcium carbonate with another bedding material like sawdust, shavings, sand, corn stalks, bark, rice hulls, and more; in addition it will be more easy to handle by the farmer and will be less abrasive for the cow udder and more comfortable .

If it is considered a daily medium amount of 2 kg by day of bedding material replaced by cubicle (Mid West Plan Service, 1993), it supposes that we must to use 1.7 kg (2 – 0.7 kg) of another bedding material in the Arqueixal farm case.

In another farms the amount of calcium carbonate to employ must to vary in relation with the stocking rate, because as much as high it is the stocking rate, lesser it should be the amount to employ by cubicle to avoid a excessive increase of calcium in soils. In table 4, are calculated the amount of calcium carbonate with another bedding material in relation with the farm stocking rate.

Table 4: Calculation of recommended composition for mixtures of calcium carbonate with another bedding material in function of stocking rate to keep the soil pH, considering a medium consumption of 2 kg cow⁻¹ day⁻¹ of total bedding material.

UGM/ha	CO ₃ Ca kg/cow/day	CO ₃ Ca kg/cow/year	Another bedding material kg/cow/day	Another bedding material kg/cow/year
2	0.55	200	1.45	529
2,5	0.44	160	1.56	569
3	0.37	133	1.63	595
3.5	0.31	114	1.69	617
4	0.27	100	1.73	631

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