EFFECTS OF DRIED PELLETIZED BROILER LITTER ON SOIL FERTILITY IN SOWN MEADOWS OF GALICIA (NW SPAIN)

Bande-Castro M.J.[1,2], López-Mosquera M.E.[2], Sainz M.J.[2]
[1]Centro de Investigacións Agrarias de Mabegondo, INGACAL, E-15080 A Coruña, Spain.
Tel:+34 981647902. mariabande@ciam.es
[2]Departamento de Producción Vegetal, Universidad de Santiago de Compostela, 27002 Lugo, Spain.
Tel:+34 982285900. mj.sainz@usc.es, melvira.lopez@usc.es

1 INTRODUCTION

Broiler chicken farms produces large amounts of manure, which generates problems from foul odours and may contain pathogenic bacteria, viruses and parasites (Sims and Wolf, 1994). Uncontrolled use of broiler litter may lead to pollution of groundwater and spreading of diseases (Moore et al., 1995). Sustainable and environmental friendly recycling of broiler litter to agricultural land reduces problems related to management and will also contribute positively to the economy of farming because fertilizing elements contained in this manure, especially P and N (Stephenson et al., 1990), improve soil productivity and thus reduce the need for adding mineral fertilizers.

The dewatering and pelletizing of broiler litter can minimize nutrient losses and environmental risks associated with its storage, while preserving its fertilizing properties and reducing potentially toxic element addition and/or increase in pathogen organisms in the soil where it is applied. Pelletized broiler litter has a reduced moisture content, which eases storing, transport and field application, and more constant nutrient characteristics than the fresh product (López-Mosquera et al., 2008). The fertilizer value of pelletized broiler litter is high, as it has high N (80% as organic N), P and K contents, and the organic N can be considered readily mineralizable (López-Mosquera et al., 2008). The aim of this work was to study the effects of a commercial fertilizer called BIOF-1, as compared with the mineral or organic fertilization usually applied by owners. The BIOF-1 is a dried pelletized broiler litter, and the effect studied was soil fertility characteristics of sown meadows, which were established in three livestock farms in northwestern Spain.

2 MATERIALS AND METHODS

Field experiments were conducted in three sown meadows established on acid soils, which had been limed prior to sowing a mixture of grasses and clovers. Main characteristics of the three soils before establishing the trials are given in table 1.

TABLE 1 **Main characteristics of sown meadows soils before establishing the trials.**

Soil characteristics	Castro	Samos	Vilalba
pH (H_2O)	6.38	5.52	5.55
% Organic matter	8.89	9.04	9.33
% N	0.27	0.24	0.22
Olsen P (mg kg^{-1})	58.75	21.19	5.81
K ($cmol_c$ kg^{-1})	0.59	0.26	0.38
Ca ($cmol_c$ kg^{-1})	11.81	3.21	2.58
Mg ($cmol_c$ kg^{-1})	1.45	0.21	0.22
% Al saturation	0.56	5.32	22.32

In each sown meadow, the following treatments were randomly applied in 8 subplots (each 250 m^2 in Castro and Samos, and 40 m^2 in Vilalba), with 4 subplots per treatment: i) fertilization applied by owners (fertilization with mineral fertilizers or cattle slurry), and ii) BIOF-1 application at a dose which varied among farms, as BIOF-1 dose aimed to level the amount of N applied by the owner. It was assumed that N available for plants in the BIOF-1 fertilizer was of about 60%. Preusch et al. (2002) reported that, 120 days after fertilizing two

different soils with fresh poultry litter, nitrogen mineralization (percent total organic N converted to inorganic N) rates in soil were of 42 in one soil to 64% in the other. Sown species and types, application dates and doses of fertilizers applied in each sown meadow are shown in Table 2.

TABLE 2 **Sown species and types, application dates and doses of fertilizers applied in treatments in each sown meadow.**

Sown meadow	Sown species	Date of application	Fertilizer treatment	
			Conventional (applied by owners)	BIOF-1 (kg ha $^{-1}$)
Castro	*Lolium perenne* L., *Lolium multiflorum* Lam., *Dactylis glomerata* L., *Trifolium repens* L., *Trifolium pratense* L.	29th April	26.3 m^3 ha $^{-1}$ cattle slurry	1667
Samos	*Lolium perenne*, *Dactylis glomerata*, *Trifolium repens*, *Trifolium pratense*	8th March	400 kg ha $^{-1}$ 8-24-16 NPK fertilizer	2000
Vilalba	*Lolium perenne*, *Lolium hybridum* Hausskn., *Trifolium repens*	14th March	292 kg ha $^{-1}$ calcium ammonium nitrate (20.5 %N)	3000

Main characteristics of BIOF-1 fertilizer were: water content 13.5 %, N 3.46 %, P 1.58 %, K 4.14 %, Ca 1.76 %, and Mg 1.13 %.

In each subplot of the three sown meadows, soil samplers where collected after a forage cut for silage in spring (made on May 30th in Vilaba and on June 21st and 20th in Castro and Samos, respectively). The soil samples were taken as cores (7 cm diameter) from 0- 15 cm depth. The soil cores where air-dried and sieved through a 2 mm mesh, to determine pH (in a 1:2.5 suspension soil/water), $HNaCO_3$-extractable P (Olsen P) by the molybdenum blue method (Olsen and Dean, 1965), and K, Ca, Mg and Al, extracted with NH_4Cl (Peech et al., 1974), by atomic emission/absorption spectrophotometry.

3 RESULTS AND DISCUSSION

The pelletized broiler litter was as effective as the conventional fertilization applied by owners to fulfil plant nutrient requirements in the three sown meadows. There were no significant differences in forage production (data not shown). After the spring forage cut soil P, K, Ca and Mg contents in the soils were as high or higher in BIOF-1 subplots than in those conventionally fertilized (Table 3), indicating that the pelletized broiler litter can be used as sole fertilizer source in meadows sown with ryegrass species, coksfoot and clover species. Sistani et al. (2004) also concluded that non pelletized fresh broiler litter can provide top yields in plots established with bermudagrass cultivars, without requiring another fertilizer.

TABLE 3 **Main characteristics of sown meadows soils after the spring silage cut in plots fertilized either with BIOF-1 or the conventional fertilization (cattle slurry in Castro and mineral fertilizers in Samos and Vilalba) made by owners. Within each soil, values of a parameter followed by a different letter are significantly different for p<0.05.**

	Castro soil		Samos soil		Vilalba soil	
	Conventional fertilization	BIOF-1	Conventional fertilization	BIOF-1	Conventional fertilization	BIOF-1
pH (H_2O)	6.14	6.18	5.32	5.44	5.28	5.43
Olsen P (mg kg^{-1})	105.60	100.09	20.39 a	39.77 b	20.62	22.47
K (cmol$_c$ kg^{-1})	0.48	0.46	0.30 a	0.40 b	0.41	0.45
Ca (cmol$_c$ kg^{-1})	10.37	12.78	1.98 a	3.02 b	1.83	2.05
Mg (cmol$_c$ kg^{-1})	1.47	1.57	0.39	0.40	0.32	0.37
% Al saturation	1.20 b	0.78 a	7.52 b	4.52 a	26.07 b	22.16 a

Our results also confirm that a high proportion of BIOF-1 total N was rapidly mineralized in the three sown meadows, becoming available for plants. In a study on N uptake by common and six hybrid bermudagrass cultivars fertilized with broiler litter, Brink et al. (2004) found that N uptake by plants represents 58% of the total applied broiler litter N, which is similar to the percentage chosen in the present work to establish BIOF-1 doses.

In subplots under the owner fertilization strategy, soil aluminium saturation percentage increased respect to those receiving BIOF-1 (Table 3), despite only four months had elapsed since the application of the pelletized broiler litter. The liming effect of BIOF-1 can be explained by its alkalinity (pH 7.9) (López-Mosquera et al., 2008). Mokolobate and Haynes (2002) also reported a liming effect of poultry litter after six weeks application to an acid Oxisol, concluding that addition of organic residues to acid soils is potentially a practicable low input strategy for reducing lime requirements. In acid soils, liming is an essential farming technique to achieve high forage yields and usually consists in large application of calcitic or dolomitic lime. Leaching of basic cations in areas of high precipitation makes the soil recover a low pH and high aluminium content, which determines the need for regular liming practices. Long term studies are needed to quantify the role of pelletized broiler litter on reducing liming requirements on acid soils that maintain meadows sown with ryegrass and clover.

4 CONCLUSIONS

The pelletized broiler litter BIOF-1 can be used as sole fertilizer source in grass-clover swards, as a result of similar or higher major nutrients supply than mineral or cattle slurry fertilizers. Respect to the fertilization applied by owners, the application of dried pelletized broiler litter favoured the maintenance of initial soil pH and aluminium saturation percentage, which was related with significantly higher soil Ca exchangeable content and availability of P assimilable for plants in Samos soil. Further studies are needed to investigate whether these effects may persist in soil at a longer term.

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