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Annual clovers performance in a dairy cows grazing system compared to perennial ryegrass.

II – Milk yield and composition

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Abstract. A grazing experiment was carried out in Galicia (NW Spain) to examine the effects of sward type on dairy cow performance and milk quality during spring. Twenty Holstein-Friesian dairy cows were randomly assigned to two grazing groups (n=10) which rotationally grazed a mixture of a hybrid ryegrass and three annual clovers (Berseem clover, Crimson clover and Persian clover ssp. *resupinatum*) (ALR) sward or a perennial ryegrass (PR) sward from last week of April to mid-July, preceded by a pre-experimental period of three weeks. Grazing was performed between the morning and evening millings and cows remained in the barn during the night, consuming a mixture composed of (on a dry-matter basis per cow) 5 kg of maize silage, 1 kg of grass hay and 2.5 kg of a commercial concentrate. Dairy cow yields of milk, milk fat and milk protein were similar for both treatments, showing the ALR an initially higher milk yield followed by a more rapid drop compared to the PR treatment. It is concluded that there is no evidence, from a productive point of view, that grazing of annual legumes is an alternative to the classical perennial ryegrass swards in the conditions of the Galician dairy cow farming.

Keywords. Annual clovers – Grazing – Milk production – Fatty acids.

Comparaison des performances de trèfles annuels et de ray-grass pérenne au sein de systèmes d'alimentation de vaches laitières en pâturages. II. Rendement et composition du lait produit.

Resumé: Une expérience d'alimentation en pâturage a été conduite au cours du printemps en Galice (NO Espagne) dans le but d'évaluer les effets du type d'herbage sur les performances des vaches laitières en termes de production et qualité du lait. Vingt vaches Holstein-Friesian furent assignées de manière aléatoire à deux groupes en pâturage (n=10) qui brouaient en rotation soit un mélange de ray-grass hybride et de trois espèces de trèfles annuels (Berseem clover, Crimson clover et Persian clover ssp. *resupinatum*) (ALR), soit un ray-grass pérenne (PR), le tout depuis la dernière semaine d'avril jusqu'à la mi-juillet précédé d'une période pré-expérimentale de trois semaines. Entre les deux traites, les bovins furent placés en pâturage durant la journée, après quoi ils furent alimentés à l'étable avec un mélange (sur la base de la quantité de matière sèche par animal) composé de 5 kg d'ensilage de maïs, 1 kg d'herbe ensilée et 2,5 kg de concentré. Les rendements obtenus en termes de production de lait, % de protéine totale et % de graisse totale furent similaires pour les deux traitements. Toutefois, les essais menés avec l'ALR ont permis d'observer dans un premier temps une plus grande production de lait mais suivie d'une baisse rapide de cette même production comparée au rendement du système basé sur le PR. D'un point de vue productif, ces essais nous permettent de conclure que l'alimentation de bovins basée sur des légumineuses annuelles ne constitue pas une alternative réelle au modèle classique basé sur du ray-grass pérenne, dans les conditions d'élevage de bovins laitiers en Galice.

Mots-clés: Trèfles annuels – Pâturages – Production de lait – Acides gras.

I – Introduction

Galician agriculture is highly specialized in dairy milk production. Dairy farms manage about one third of Utilized Agricultural Area and generate 40% of the Gross Value Added of the agricultural

sector in the region (López-Iglesias *et al.*, 2013). Dairy cow's production is 2.5 million tonnes, accounting for more than 40% of total milk cow's production in Spain. This figure makes Galicia, the NW Atlantic region of Spain, to be amongst the 10 EU regions with the highest level of dairy cow's production (Eurostat, 2013). The dairy production model in Galicia has evolved towards an intensive use of land, in which the rotation of Italian ryegrass with forage maize in a double cropping system is dominant amongst the more productive farms (Fernández-Lorenzo *et al.*, 2009). In order to increase the protein output of this system there is evidence that annual clovers can play a role when grown for silage as a winter crop and harvested in mid-spring, based on their good productivity (Valladares *et al.*, 2012) and high protein content (Pereira-Crespo *et al.*, 2012).

On the other hand, there has been a growing interest among Galician dairy farmers about the possibility of differentiating their milk on the base of its fatty acids (FA) profile, taking advantage of better prices from the dairy industry. With this purpose, it is generally adopted a feeding strategy in which expensive sources of polyunsaturated vegetable oils (e.g. linseed) are included in the diet. Another approach, followed by a minor group of farmers, relies on the grazing of pastures composed mainly by perennial ryegrass, which is the dominant specie in Galician swards. It is well-known that feeding of fresh pastures to dairy cows improve the polyunsaturated FA concentration in milk fat (Dewhurst *et al.*, 2006) in a more economical and rational fashion compared with the supplementation of the diet of stall-fed cows. With this scope, the use of legume species in the pastures offer additional advantages compared with the use of ryegrass-dominant swards, based not only in an enhanced milk yield and FA profile (Dewhurst *et al.*, 2009), but in the economy of nitrogen inputs in the farm and in a positive effect on the reduction of greenhouse gas emissions (Peeters *et al.*, 2006).

There is a lack of published information about the potential of annual clovers to be used in the feeding of dairy cows as a grazing resource. In the present work it is studied the effect of grazing a mixture of three annual clovers and a hybrid ryegrass sward, compared with a pure perennial ryegrass sward, on milk yield and FA composition with the objective of gaining insight in the role of annual legumes for improving the forage systems in the Atlantic dairy production area of Spain.

II – Materials and methods

A field experiment was performed from April to July 2015 at the Centro de Investigacións Agrarias de Mabegondo (CIAM) research station farm (Galicia, NW Spain, 43° 15'N, 8° 18'W, 100 m altitude). In the autumn of 2014 two plots of 2.0 ha each were seeded with a mixture of annual clovers composed by Berseem clover (*T. alexandrinum* L. cv. Alex), Crimson clover (*T. incarnatum* L. cv. Viterbo) and Persian clover (*T. resupinatum* L. ssp. *resupinatum* cv. Nitroplus) and a hybrid ryegrass (*Lolium hybridum* Hausskn. cv. Barsilo) (sward ALR) or a pure stand of perennial ryegrass (*Lolium perenne* L. cv. Barsintra) (sward PR). Twenty Holstein-Friesian cows with a milk yield of 37.5 ± 6.8 kg/head/day and a live weight of 590 ± 66 kg were randomly distributed into two equal groups of ten cows each (two primiparous cows per group) and assigned to one of the two pastures. Cows were managed with electric fencing to strip-graze the paddocks from the last week of April to mid-July. Grazing was allowed after the morning milking, during a 10 hours per day (8:00 am to 18:00 pm), after which cows were fed in the barn a mixture composed of (on a dry-matter basis per cow) 5 kg of maize silage, 1 kg of grass hay and 2.5 kg of a commercial concentrate with a 25% of crude protein (CP).

Individual milk yield was recorded daily at the parlor using the DeLaval Alpro System and milk samples were taken per animal in the morning and evening milking of 3 consecutive days in the weeks 3, 6, 9 and 12 of the experiment (n=480). Milk samples were immediately stored at 4°C and transported to the Laboratorio Interprofesional Galego de Análise do Leite (LIGAL) where they were subjected to routine FTMIR analysis using a MilkoScan™ FT6000 (Foss Electric A/S, Hillerød, Denmark). The milk samples were analyzed for: chemical composition (fat, protein,

lactose and non-fat solids), urea and FA profile. Blood samples were taken from the tail vein of each cow using vacutainer sampling tubes and analyzed for the urea content by the enzymatic method in a veterinary laboratory.

Data were subjected to ANOVA analysis using the model $y = \mu + \alpha_i T + \beta_j P + (\alpha\beta)_{ij} T \times P + X_{ijk} + \varepsilon_{ijk}$, where T is the pasture type (fixed factor), P is the week of the experiment (random factor) and X stands for the covariates (days in milk, parity, initial yield and initial live weight) used in the analysis. The separation of means was performed by Duncan's multiple range procedure and all the analyses were done using Proc GLM and Proc Mixed procedures of SAS package (SAS Institute, 2009).

III – Results and discussion

Daily yield of milk, milk fat and milk protein (mean values of 27.94 and 27.12, 1.09 and 1.05, 0.78 and 0.75 kg cow⁻¹ day⁻¹ for ALR and PR, respectively) were not affected by pasture type (Table 1).

Table 1. Effect of pasture type and interaction of pasture type x period on milk yield and composition

	Pasture type			Pasture type x Period								p
	ALR	PR	p	ALR				PR				
				P1	P2	P3	P4	P1	P2	P3	P4	
Yield (kg cow ⁻¹ day ⁻¹)												
Milk [†]	27.94	27.12	ns	32.37	28.16	24.75	25.95	27.51	28.38	26.32	26.26	***
Fat	1.09	1.05	ns	1.27	1.10	0.96	0.99	1.07	1.07	1.02	1.05	***
Protein	0.78	0.75	ns	0.88	0.77	0.70	0.74	0.74	0.81	0.74	0.71	***
Non-fat solids	2.22	2.14	*	2.56	2.25	1.98	2.05	2.20	2.29	2.07	2.01	***
Milk composition (%)												
Fat	4.16	4.16	ns	4.23	4.19	4.15	4.08	4.11	3.87	4.19	4.48	***
Protein	2.97	2.97	ns	2.93	2.95	2.99	3.03	2.85	2.94	3.03	3.04	***
Lactose	4.72	4.66	***	4.74	4.79	4.74	4.60	4.70	4.57	4.67	4.68	***
Non-fat solids	8.48	8.41	*	8.48	8.54	8.52	8.37	8.38	8.31	8.46	8.48	ns
Milk fatty acids (% total FA)												
SFA	70.93	69.83	**	70.84	70.90	71.00	70.99	68.81	70.07	70.61	69.87	ns
MUFA	23.74	24.30	ns	23.70	23.04	23.72	24.56	25.06	23.04	23.68	25.39	ns
PUFA	1.67	1.71	ns	2.14	1.54	1.44	1.53	2.04	1.45	1.61	1.74	**
Urea												
Milk urea (mg L ⁻¹)	168	129	***	163	150	151	210	93	77	144	202	***
Blood urea(mg dL ⁻¹)	18.66	16.21	***	15.48	15.37	21.17	23.24	13.11	13.41	17.46	20.93	ns

ALR: mixture of three annual clovers with a hybrid ryegrass pasture; PR: perennial ryegrass pasture; P: period; P1: 27 April-17 May; P2: 18 May-7 June; P3: 8 June-28 June; P4: 29 June-19 July

[†] Fat and protein corrected milk production (3.5% fat, 3.5% protein); SFA: saturated fatty acids; MUFA: monounsaturated fatty acids; PUFA: polyunsaturated fatty acids; * p<0.05; ** p<0.01; *** p<0.001; ns: non significant.

Non-fat solids yield showed a slight, although significant (p<0.05) higher value for ALR compared with PR (2.22 vs 2.14 kg cow⁻¹ day⁻¹). Fat and protein concentration in milk (overall average values of 4.16 and 2.97%, respectively) were not significantly different between the ALR and the PR treatments, whilst the milk contents of lactose (4.72 vs 4.66%, p<0.001) and non-fat solids (8.48 vs 8.41%, p<0.05) were higher for the ALR pasture compared with PR, respectively. Milk fat from the PR pasture showed a less saturated profile compared with ALR (p<0.01) with mean values of saturated fatty acids (SFA) of 69.83 and 70.93 % total FA,

respectively, whilst no differences ($p>0.05$) were found between the two pastures for the monounsaturated (MUFA) and polyunsaturated (PUFA) fatty acids content of milk. Milk and blood urea from cows grazing the ALR pasture showed higher values ($p<0.001$) compared with those fed in the PR pasture (milk urea 168 vs 129 mg L⁻¹ and blood urea 18.66 vs 16.21 mg dL⁻¹, ALR and PR respectively), probably reflecting a higher protein/energy ratio in the ALR sward, although urea values in both treatments are in a range that can be considered as normal in the dairy cow's feeding.

It was noted a faster decrease in the daily yields of milk, milk fat and milk protein with the advancement of the lactation for the cows grazing the ALR pasture, with a weekly variation per cow of -0.71 vs -0.13 kg of milk, -31.1 vs -2.0 g of fat and -15.5 vs -3.3 g of protein, reflecting a more accelerated loss of quality of the ALR pasture compared with the PR pasture with the advance of the grazing season (Veiga *et al.*, 2016). On the other hand, the SFA and MUFA content of milk fat remained almost constant during the grazing season, being observed a more rapid loss of the PUFA profile for the cows grazing the ALR sward.

IV – Conclusions

No relevant differences were found between cows grazing a mix of annual legumes and ryegrass sward comparing to a perennial ryegrass sward in terms of milk yield and milk composition of cows during the mid-spring mid-summer grazing period. From this point of view, it was not observed any advantage of the use of annual legumes over the predominant grass species in the dairy grazing systems of the Atlantic NW zone of Spain.

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