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Abstract. *Piptatherum miliaceum* (L.) Coss smilo grass, is a Mediterranean perennial native grass species whose forage potential is unexplored. Little information is available about smilo grass seasonal production and biomass quality. CNR-ISPAAM activity focused on the evaluation for forage use of some smilo grass accessions collected in Sardinia in comparison with conventional forage species. Eight smilo grass accessions were grown in spaced plant stands, using tall fescue and cocksfoot as control. Plots were harvested three times during the years 2013-2015 and DMY and forage quality were assessed. Significant differences were found among DMYs of conventional forage species and smilo grass, with smilo grass producing less than tall fescue but more than cocksfoot in each harvest season except for the end of spring. The content of crude protein of smilo grass was significantly higher than that of conventional species in all seasonal cuts, as well as NDF, while ADL was higher at the end of spring. On the basis of these preliminary outcomes, the potential role of smilo grass into rainfed extensive farming systems is discussed.

Key-words. *Piptatherum miliaceum* – Native species – Forage.

Potentiel fourrager de* Piptatherum miliaceum *(L.) Coss (piptathère faux millet)

Resumé. *Le* Piptatherum miliaceum *(L.) Coss (piptathère faux millet) est une plante herbacée vivace indigène de la Méditerranée dont le potentiel fourrager est non exploité. Peu d'informations sont disponibles sur la production saisonnière et la qualité de la biomasse. Les activités du CNR-ISPAAM ont été concentrées sur l'évaluation fourragère de certaines populations naturelles de* P. miliaceum *collectées en Sardaigne, en comparaison avec des espèces fourragères traditionnelles. Huit accessions de* P. miliaceum *ont été semées en parcelles et comparées à la fétuque et au dactyle utilisés comme témoins. Les parcelles ont été fauchées trois fois au cours de l'année (saison 2013-2015) en évaluant le rendement en matière sèche (RMS) et la qualité du fourrage. Des différences significatives de rendements ont été trouvées entre les espèces fourragères traditionnelles et* P. miliaceum *dont le rendement est inférieur à celui de la fétuque mais plus élevé que celui du dactyle et ceci pour chaque coupe, sauf à la fin du printemps. La teneur en protéines brutes et en NDF était significativement plus élevée chez* P. miliaceum *que chez les deux espèces classiques pour toutes les coupes saisonnières, mais l'ADL était plus élevée à la fin du printemps. En se basant sur ces résultats préliminaires, le rôle potentiel de* P. miliaceum *dans les systèmes d'élevage extensif pluviaux a été discuté.*

Mots-clés. Piptatherum miliaceum – *Espèces indigènes – Fourrage.*

I – Introduction

Perennial grasses show economic and environmental advantages that make them attractive for agronomic exploitation in grasslands. They usually show a better water use efficiency than annual grasses, an adequate productivity and ability to grow in poor soils, they bring ecological benefits for soil and wildlife habitats and when they are native, their impact on the environment is even more sustainable. Currently, the native germplasm of Mediterranean perennial grasses is little investigated for forage purposes (Annicchiarico *et al*., 2013).

Piptatherum miliaceum (L.) Coss, is a perennial native winter-active growing species. It produces palatable forage and it is grazed by livestock in natural environments (Celik, 1998). Its attractiveness relies on its ability to face summer drought and to grow on marginal soils, as

slopes, roadsides, rocky soils. Moreover, the species had showed a potential to be used as multipurpose species (bioenergy, environmental restoration, etc.) (Sulas *et al*., 2015).

This study aimed to evaluate seasonal DMY and forage quality of smilo grass in comparison with tall fescue and cocksfoot.

II – Materials and methods

The trial was carried out in the experimental field of CNR-ISPAAM in Sassari (40° 45' N, 8° 25' E, 24 m a.s.l.). The soil was sandy-clay-loam, poor in total nitrogen (0.96‰), with adequate content of phosphorous and organic matter and alkaline pH.

Eight native accessions of *P. miliaceum* were transplanted in the field in April 2012. Seedlings were obtained by seeds collected from wild populations growing in Sardinia. Two high-yielding conventional perennial forage species as *Festuca arundinacea* cv. 'Flecha' and *Dactylis glomerata* ecotype 'Ottava' were used as control. Twenty-four seedlings per species and accession were transplanted in plots (1.50 x 2.0 m) arranged in a completely randomized design with three replicates. In each plot, 8 spaced plants were grown in two rows (0.5 x 0.5 m). Plots were entirely under rainfed conditions. A cleaning cut was made in July 2012. A first mowing at the end of the first growing season was done in July 2013 (data not shown). In this study we considered the harvesting carried out at the end of autumn, winter and spring in the years 2013-2014 and 2014-2015. At each harvest, two plants per plot were cut and weighted in the lab. After being oven-dried at 60 °C up to constant weight, plant samples were re-weighted and aboveground dry matter yield (DMY) estimated. Dried samples of the season 2013-2014 were ground to determine crude protein content (CP) by Kjeldahl method, ashes, neutral and acid detergent fibres (NDF and ADF) and acid detergent lignin (ADL) by the procedure of Van Soest *et al*. (1991).

For statistical analyses, one-way ANOVA was carried out using the software Statgraphics Centurion xv to calculate the differences between accessions during the two growing seasons. Homoscedasticy of data was assessed by Bartlett's test. Mean differences among treatments were separated by Fisher's least significant difference (LSD) at 0.05 probability level.

III – Results and discussion

1. Meteorological pattern

In the first year of observations (July 2013-June 2014) cumulated rainfall exceeded the average rainfall for the area (550 mm) reaching 625 mm. Rainfall was well distributed between September and March (90%) with a peak in November (135 mm). From July 2014 to June 2015, the total rainfall was 470 mm. The greater amount (60%) of total rainfall was concentrated in two months: November (129 mm) and February (136 mm). Temperatures differed between the two years in winter months. In November and December 2014, minimum monthly temperatures were higher (+2.2 and +4.1 °C, respectively) than in the corresponding months of the previous year.

2. Dry matter yield

In the first year of observation, which includes the first three cuts, the mean DMY of accessions, regardless of species, was higher than in the second year (Table 1), probably due to the higher water availability. Cumulated DMY per plant ranged between 264 g in *D. glomerata* and 877 g in *F. arundinacea* and between 94 g in PM22 and 411 g in *F. arundinacea* in the first and second year, respectively. The mean DMY in *P. miliaceum* was 508 g in the first year and 205 g in the second year (data not shown). For both years, the PM18 accession of *P. miliaceum* showed

DMYs not differing from that of *F. arundinacea*. In autumn and winter, tall fescue showed the best production in absolute values, as expected from a selected variety. Nonetheless, in autumn, the DMY of several *Piptatherum* accessions (3 among 8 in autumn 2013 and 5 among 8 in autumn 2014) were statistically similar to those of *Festuca.* This is noteworthy, being the observed genotypes from native populations. *P. miliaceum* was characterized by a higher DMY than conventional forage species in spring when *F. arundinacea* and *D. glomerata* dried up their aboveground biomass to cope with summer drought. Smilo grass showed later flowering and later leaf senescence than conventional species as reported by Sulas *et al.* (2015). DMY of *P. miliaceum* ranged between 15 and 309 g plant^{-1}, 25 and 206 g plant^{-1} and 45 and 213 g plant^{-1} in autumn, winter and spring, respectively.

Table 1. Dry matter yield of *P. miliaceum* accessions (PM), *D. glomerata* (DA) and *F. arundinacea* (FE). Different letters in the same column indicate that means are statistically different (LSD, p<0.05)

Accession	DMY (g plant^{-1})					
	23.12.2013	**10.04.2014**	**01.07.2014**	**22.12.2014**	**02.04.2015**	**25.06.2015**
DA29	96.6 c	92.9 c	74.7 b	30.6 bc	72.4 b	63.7 cde
FE28	362.0 a	460.7 a	54.8 b	98.7 a	243.5 a	69.0 bcde
PM13	186.3 bc	137.4 bc	136.6 ab	54.9 abc	56.0 b	135.5 a
PM14	207.0 bc	185.2 bc	145.8 ab	61.0 abc	45.2 b	115.0 abcd
PM15	278.7 ab	123.8 bc	95.5 b	77.5 abc	29.9 b	122.0 abc
PM16	309.0 ab	164.5 bc	194.9 a	83.3 ab	43.3 b	86.9 abcde
PM18	282.4 ab	206.0 b	213.5 a	100.7 a	55.4 b	126.6 ab
PM19	199.8 bc	168.8 bc	76.1 b	15.1 c	30.6 b	56.8 de
PM22	121.7 c	79.5 c	82.2 b	23.9 bc	24.9 b	45.0 e
PM24	226.6 bc	157.4 bc	87.3 b	26.7 bc	33.1 b	115.8 abcd

3. Quality of biomass

The overall quality of *P. miliaceum* was medium-low in each season. NDF values were relatively high starting from autumn production (>60%) and increases, as expected (Bullitta, 1993) with the phytomass maturity (Table 2). However, no significant differences for NDF content were observed between smilo grass accessions and the two conventional forage species in autumn. The two accessions of smilo grass (PM13 and PM22) showed similar values of NDF to *D. glomerata* and lower values than *F. arundinacea* in winter. ADF showed the most suitable values for animal nutrition in autumn and winter as well as ADL. A wide range of variation was observed among smilo grass accessions for ADF along seasons. Nonetheless, *P. miliaceum* showed satisfactory contents of crude protein (>15% and 8% in in autumn and spring, respectively), comparable or higher to those of *F. arundinacea* and *D. glomerata* (in autumn and spring) and higher than both conventional species in winter production (>13%). Ash content was generally high; it was higher in smilo grass accessions than in conventional grasses in winter and comparable to them in autumn and spring.

IV – Conclusions

P. miliaceum showed an interesting potential as forage plant (i.e. accessions PM13 and PM18). The strength of smilo grass as feed relied mainly on the amount of DMY and its quality harvested in autumn and winter. Although its production was lower than in Festuca in these seasons, the variation for this trait shown by the accessions of *P. miliaceum* may offer the chance to carry out future selection and breeding programmes to maximise both forage production and its quality. Moreover, the crude protein content in the biomass may be exploited

despite the high levels of NDF. Nonetheless, this trait could be improved by agronomic management aiming to maintain active growth of *P. miliaceum*. Under rainfed Mediterranean conditions, smilo grass seems suitable for dual use as forage in the early stage of growth and as lignocellulosic feedstock for bioenergy at the end of growing season (senescent plants). Moreover, it can be more acceptable by farmers than rhizomatous species thanks to its easy establishment (seed propagation) and harvesting.

Table 2. Nutrient content of dry matter of *P. miliaceum, F. arundinacea* and *D. glomerata* in autumn, winter and spring for the first year (2013-2014). Different letters in each column and date indicate significant differences in mean values (p<0.05)

Accession	NDF (%)	ADF (%)	ADL (%)	Crude protein (%)	Ashes (%)
	23.12.2013 (autumn production)				
DA29	57.3 b	39.4 a	7.4 a	13.3 c	17.2 a
FE28	58.0 ab	36.3 c	6.4 a	15.8 bc	13.9 b
PM13	61.6 ab	33.4 d	6.8 a	18.0 ab	12.5 bcd
PM14	62.6 a	36.9 bc	6.1 a	15.4 bc	11.5 cd
PM15	61.0 ab	38.6 ab	6.8 a	21.4 a	11.2 cd
PM16	61.5 ab	37.5 abc	6.7 a	21.5 a	10.8 d
PM18	61.5 ab	33.9 d	5.7 a	17.5 ab	12.7 bc
PM19	61.1 ab	34.3 d	4.9 a	17.7 ab	12.4 bcd
PM22	60.8 ab	33.2 d	6.0 a	18.8 ab	13.5 b
PM24	61.9 ab	34.3 d	6.3 a	17.9 ab	12.6 bc
	10.04.2014 (winter production)				
DA29	58.3 d	37.7 ab	2.9 c	8.3 d	14.5 abcd
FE28	62.7 bc	40.0 a	3.2 bc	9.0 d	9.7 e
PM13	58.9 d	35.0 bc	3.7 abc	15.6 bc	16.3 ab
PM14	62.8 bc	37.5 ab	3.4 abc	13.7 c	16.3 ab
PM15	64.2 ab	37.0 ab	3.2 bc	18.9 ab	13.3 d
PM16	67.4 a	37.4 ab	4.3 a	24.2 a	13.9 cd
PM18	64.4 ab	35.9 bc	3.9 ab	17.2 bc	15.9 abc
PM19	64.9 ab	32.4 c	3.7 abc	15.3 bc	14.6 abcd
PM22	60.4 cd	34.4 bc	3.6 abc	18.2 bc	16.6 a
PM24	63.5 bc	34.5 bc	3.8 abc	18.2 bc	14.4 bcd
	01.07.2014 (spring production)				
DA29	64.6 e	44.7 a	7.2 bc	6.1 b	14.0 a
FE28	61.8 f	39.8 d	5.2 d	6.9 b	15.4 a
PM13	70.7 b	40.5 d	12.7 a	8.8 ab	9.5 bcde
PM14	73.5 a	44.5 ab	8.5 bc	7.9 ab	9.2 cde
PM15	70.4 bc	43.5 ab	7.1 bc	10.7 ab	8.7 de
PM16	73.1 a	44.5 ab	8.5 bc	10.2 ab	7.9 e
PM18	70.8 b	44.4 ab	9.0 b	13.5 a	9.9 bcd
PM19	68.9 bcd	44.8 a	7.4 bc	8.5 ab	10.9 b
PM22	68.5 cd	41.3 cd	6.9 c	8.8 ab	10.7 bc
PM24	68.2 d	42.7 bc	6.7 cd	9.5 ab	10.7 bc

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