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Dry Matter production and Nutritive Value of a natural pasture grazed by wild horses over a two years period

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Abstract

In Molise Region (Italy) are still bred some autochthonous populations and, between them, some wild horses named "Pentro Horses" that recently have been included in the list of horses at risk of extinction. The breeding area is 2200 hectares extended and includes a broad plane surrounded by wooden hills. The aim of this research was to value nutritional characteristics of this area over a two years period to improve the management of the herd and to define the stocking rate in relation to the forage production in terms of production and quality. The forage samples were collected from 5 experimental areas that represent the prevalent land typology (2 areas for the pasture system and 3 areas for grazing meadow system) according with the Corral and Fenlon method (1978). These samples were analysed for dry matter(DM) and gross energy; the nutritive value, expressed in Horse Fodder Units(HFU, INRA) was determined also. The DM and HFU total production (May to October) was determined to be compared with the total nutrient requirements of the herds. Data were analyzed by a one-way ANOVA, using month and area as factors. The results show a low production/ha; nevertheless, because of the low stocking rate (0.3-0.6 head/ha), nutrient production satisfies the nutrient requirements of the horses for what concerns dry matter and energy. Anyway, it is necessary to underline that in case of restricted precipitations in summer time, grass production could be inadequate (August and September 2000). Therefore, increasing the total number of heads could be possible, but during the most critical months it would be necessary to plan a strict monitoring of the environment and to examine a different management of the herd (hay integration, pasture rotation) to avoid pasture and soil degradation.

Key words: autochthonous populations, horses, pasture, nutritional characteristics

Introduction

Few autochthonous equine populations are still bred in Italy and, between them, some wild horses located in Molise Region (Montenero Valcocchiara – Isernia district) that are named "Pentro Horses" and that have recently been included in the list of horses populations at risk of extinction (MiPAF, 2003). The breeding area is located between 800 and 900 meters of altitude, is 2200 hectares extended and includes a broad plane surrounded by wooden hills. The horses spend most part of their time in the plane from the beginning of the vegetative activity, generally corresponding to spring time (April/May) till October because of the considerable availability of forage. From November to April the horses move to the surrounding hills because of the abundant overflow of the plane: in this period they satisfied

their nutrient requirements from the copious deciduous wood and shrubby vegetation; in this period horses come to the plane only for watering. A part of the plane is managed using the grazing meadow system that includes an hay first cut followed by grazing. Nevertheless, the hay production is not destined to horses but to a dairy cows herd that is bred near the plane. Previous papers (Iamartino *et al*., 2004; Lucchese, 1995; Miraglia & Pilla, 1998; Miraglia *et al*., 1999, 2001, 2002a) showed the genetic characteristics of these horses, the zootechnical practices and the environmental aspect of the areas concerning vegetation and forage production. Herds are kept wild all over the year and no support (food supplies or health care) is provided. At present foals are sold mainly for meat production. This paper is only a part of an important research project, carried out over a two years period, concerning the valorisation of the area in relation to the safeguard of the horse population and to the environment to prevent pasture and soil degradation. Particularly, the aim of this paper concerns with the evaluation of the availability and of the nutritional characteristics of the forage in order to satisfy horse requirements and to plan a correct stocking rate to avoid pasture degradation.

Material and Methods

The seasonal dry matter and net energy production of two subsequent years, from April to October, were determined after collection of samples from 5 experimental areas that represented the prevalent land typology. The sampling technique referred to the Corral and Fenlon method (1978). Two of these areas were placed in the part of the land destined to grazing only (pasture system); the other three sampling areas were placed into an area that was grazed only after hay production in July (grazing meadow system). The experimental particles of each area (10 m^2) were divided into two groups of three particles of 0.5 m^2 each one. They were alternatively mowed every two weeks with a regeneration time of 28 days. The mowing started at the beginning of the vegetative activity for the pasture system and after harvesting for grazing meadow system; it ended in October, with the vegetative fallow. The forage samples were analyzed for dry matter (DM) (AOAC, 2000) and gross energy (GE) (Nehring & Haenlein, 1973). The nutritive value, expressed in Horse Fodder Units(UFC French system, INRA, 1984) was determined by regression equation (Martin-Rosset & Vermorel, 2002) using crude protein (AOAC, 2000) and crude fibre (AOAC, 2000) percentage. The monthly productions of dry matter and HFU were compared to the monthly requirements of the herds (Martin-Rosset, 1990), increased of 20% quota because of the considerable daily physical activity. The monthly rainfall was taken at rain gauge station of Montenero Valcocchiara. Data were analyzed by one-way two factor ANOVA, using month, area and their interaction as factors. The Bonferroni *t* test was used for mean comparisons, and the level of significance (α) was set at 0.05. Before statistical analysis, data were examined for normality and variance equality. In cases of unequal variance, the transformed (logarithmic) data were analyzed to confirm the conclusions. All analyses were conducted using SPSS (release 12.0.1, copyright © SPSS Inc., 1989-2003).

Results and Discussion

Table 1 shows the monthly pluviometric trend over two following years: in autumn and spring time the rainfall was abundant while water deficiency occurred from June to September. The comparison between the two years points out that the most important differences occurred in this period, when water request is highest: in the first year, in fact, from June to September the pluviometer recorded 85.2 mm, while in the second one 150.4 mm. Therefore, in 2000 meadow grass suffered a greater water deficiency. This is confirmed by DM percent values specified in Table 2. In both the years there was a progressive increase of DM content in

summer time and a decrease in autumn. Available data support this trend (AA.VV., 1989; Catalano & Miraglia, 1985, 1986; Catalano *et al*., 1987; Martillotti *et al*., 1996); yet in the first year this trend is more distinct and also areas' means are greater than in the second one, confirming a water deficit in the first year. The differences among the areas could be due to the different draining capacity of the soil and to the different management of the grazing land: in the pasture system the average DM content and the monthly variations are lower than in the grazing meadow system. This is probably due to the greater impoverishment of water vegetation reserves in the grazing meadow system before harvesting and to the stress caused by mowing. Table 3 shows the GE content of pasture and grazing meadow systems during the two years monitored: the outcome appear comparable to available data in similar conditions (Martillotti *et al*., 1996). This data doesn't show a clear seasonal trend; nevertheless, such results distinctly show that the considerable summer dryness of the first year influenced negatively the GE values. Particularly, it is important to underline that the considerable water deficit of the first year increased the differences among the areas, while the high water availability of the second year decreased them. Table 4 and 5 respectively show DM and HFU production over the two years. The general trend show a low production, excepted in the months of May and June, but comparable to similar conditions (AA.VV., 1989; Catalano & Miraglia, 1985, 1986; Catalano *et al*., 1987). Most part of this variability is linked to the variation of climatic conditions during the vegetative season and the different years. The DM and HFU productions show a clear decreasing trend from May to October. Only in October 2000, because of the abundant rainfall, the forage regain is enough consistent to increase DM and Net Energy production. Differences are consistent also considering the different management of the pasture: DM and HFU productions of the pasture system are higher than those of the grazing meadow systems. The differences between the two thesis of pasture systems are probably due to the considerable water availability of the Pasture system 2 because it is near a hill torrent. Table 6 shows the number of horses of the different classes averagely observed over the two years and their daily DM and HFU requirements. In the period between May and June the total DM and HFU requirements of the herds (barren and pregnant mares, young horses) were respectively estimated about 1839 kg/day and 1090 HFU/day; in the following months they increased to 2645 kg/day and 1560 HFU/day (July-August) and to 3125 kg/day and 1848 HFU/day (September-October) because of the physiological changes of the mares(from pregnancy to lactation) and because of the foals nutrient requirement increase. Nevertheless, these requirements are generally low if compared to the total DM and HFU productions of the area during the period observed, as shown in table 7. The limited available pasture surface in the period April-June is compensated by the high production/ha; on the other side, the following decrease of production due to dryness is balanced by the increase of the pasture surface (after harvesting, from July on). However, in the case of rainfall decrease, forage production could not satisfy animal requirements, as it happened in August and, particularly, in September 2000, when DM production was lower than requirements and HFU production was scarcely adequate. Therefore, it seems obvious that the most important limiting factor to satisfy the nutrient requirements is the water availability in the summer months. Actually, even though nutrient production corresponds to the typical situations of marginal areas in Central-Southern Italy (Miraglia, 1989, Miraglia *et al*., 2002b, Olivieri *et al*., 1988), it is only the low stocking rate (0.6 head/ha in April-June; 0.3 head/ha in July-October) that agrees to satisfy the herds requirements as confirmed by the apparent good body condition of mares and foals in October.

Conclusions

The presence of an equine population in an area of particular environmental interest could determine some problems of compatibility between grazing and high vulnerability plants. At the same time it is necessary to preserve, on one hand, some rare botanical species and on the other one Pentro horses from extinction. The results obtained in these two years showed that the forage production is averagely higher than herds requirements and, therefore, the pasture can sustain the present stocking rate; yet, it is necessary to underline that in case of limited rainfall in the summer months, grass production could be inadequate. Consequently, increasing the total number of heads could be possible, but during the most critical months it would be necessary to plan a strict monitoring of the environment and to examine a different management of the herd (hay integration, pasture rotation) to avoid pasture and soil degradation.

Table 1 – 2000 and 2001 rain gauge records (mm)[1]

Month	2000	2001
January	20.6	103.4
February	23.8	39.8
March	66.2	90.8
April	51.4	77.4
May	106	40.2
June	11.4	15.4
July	21.2	14.2
August	15.4	45.4
September	37.2	75.4
October	165	18.8
November	241.4	137.2
December	149.2	92.2
Total	908.8	750.2

[1] Rain gauge station of Montenero Valcocchiara (IS)

Table 2 – Dry Matter percentage referred to the pasture areas (Past. a. 1; Past. a. 2) and to the grazing meadow areas (Graz. m. a. 1; Graz. m. a. 2; Graz. m. a. 3) (mean values ± s.e.)

Date	Past.a.1	Past.a.2	Graz.m.a.1	Graz.m.a.2	Graz.m.a.3	months' means[1]
May 2000	24.6±0.3	17.1±0.4	-	-	-	20.8±1.3^{a}
May 2001	23.8±1.1	19.3±0.7	-	-	-	21.5±1.0^{a}
June 2000	26.1±1.1	19.8±0.4	-	-	-	23.0±1.0^{ab}
June 2001	25.1±1.6	19.9±0.4	-	-	-	22.5±1.0^{ab}
July 2000	31.7±0.9	23.3±0.6	61.5±1.4	45.7±0.9	40.2±0.6	40.5±0.7^{e}
July 2001	32.5±1.3	21.7±0.4	61.3±4.8	41.8±1.2	29.4±0.9	37.4±0.7^{de}
Aug.2000	35.7±0.9	29.7±0.9	64.1±1.1	37.0±2.4	35.7±2.3	40.4±0.7^{e}
Aug.2001	27.9±1.2	21.4±0.5	34.9±1.3	32.5±1.9	25.2±1.0	28.4±0.7^{c}
Sept.2000	38.3±1.6	-	-	34.7±1.1	30.9±0.5	34.6±1.0^{d}
Sept.2001	27.7±1.0	21.7±0.4	30.4±2.1	26.5±1.1	25.2±0.4	26.3±0.7^{bc}
Oct. 2000	23.5±1.1	-	26.5±0.7	23.5±2.0	27.9±0.9	25.4±0.8^{ab}
Oct. 2001	30.3±0.8	20.0±1.1	23.0±3.7	28.6±0.6	27.4±2.4	25.9±0.7^{bc}
Areas' means[2]						
2000	30.0±0.6^{bc}	22.5±0.8^{a}	50.7±0.9^{f}	35.2±0.7^{de}	33.7±0.8^{d}	
2001	27.9±0.6^{b}	20.7±0.6^{a}	37.4±0.7^{e}	32.4±0.7^{cd}	26.8±0.8^{b}	

[1] Different superscripts (a,b,c,d,e) within the column indicate significant differences (P<0.05)
[2] Different superscripts (a,b,c,d,e,f) within columns and rows indicate significant differences (P<0.05)

Table 3 – Gross Energy values (MJ/kg DM) referred to the pasture areas (Past. a. 1; Past. a. 2) and to the grazing meadow areas (Graz. m. a. 1; Graz. m. a. 2; Graz. m. a. 3) (mean values ± s.e.)

Date	Past.a.1	Past.a.2	Graz.m.a.1	Graz.m.a.2	Graz.m.a.3	months' means[1]
May 2000	18.6±0.5	16.9±0.3	-	-	-	17.7±0.2^{a}
May 2001	20.4±0.4	19.9±0.2	-	-	-	20.1±0.2^{cdef}
June 2000	19.7±0.2	19.0±0.3	-	-	-	19.3±0.2^{bc}
June 2001	20.1±0.1	19.5±0.2	-	-	-	19.8±0.2^{bcde}
July 2000	19.6±0.1	19.0±0.1	20.1±0.2	21.2±0.2	18.9±0.3	19.8±0.1^{bcd}
July 2001	20.2±0.2	19.3±0.1	20.2±0.7	20.7±0.2	20.1±0.5	20.1±0.1^{cde}
Aug.2000	20.1±0.1	20.0±0.2	17.6±0.6	20.4±0.3	19.9±0.4	19.6±0.1^{bc}
Aug.2001	20.3±0.2	20.0±0.3	20.7±0.1	20.9±0.2	20.3±0.3	20.5±0.1^{ef}
Sept.2000	20.4±0.2	-	-	19.8±0.4	19.7±0.2	20.0±0.2^{cde}
Sept.2001	20.0±0.1	19.7±0.2	20.1±0.2	20.8±0.5	20.7±0.1	20.2±0.1^{def}
Oct. 2000	20.2±0.4	-	16.1±0.9	20.7±0.2	19.3±0.4	19.1±0.1^{b}
Oct. 2001	21.1±0.3	20.3±0.3	20.9±0.3	21.1±0.1	21.1±0.6	20.9±0.2^{f}
Areas' means[2]						
2000	19.7±0.1^{cd}	18.7±0.1^{b}	17.9±0.2^{a}	20.5±0.1^{f}	19.5±0.1^{c}	
2001	20.3±0.1^{def}	19.8±0.1^{cde}	20.5±0.2^{ef}	20.9±0.2^{f}	20.6±0.2^{f}	

[1] Different superscripts (a,b,c,d,e,f) within the column indicate significant differences (P<0.05)
[2] Different superscripts (a,b,c,d,e,f) within columns and rows indicate significant differences (P<0.05)

Table 4 – Dry Matter production (kg/day/ha) referred to the pasture areas (Past. a. 1; Past. a. 2) and to the grazing meadow areas (Graz. m. a. 1; Graz. m. a. 2; Graz. m. a. 3) (mean values ± s.e.)

Date	Past.a.1	Past.a.2	Graz.m.a.1	Graz.m.a.2	Graz.m.a.3	months' means[1]
May 2000	46.4±5.4	73.8±4.9	-	-	-	60.1±2.8^{g}
May 2001	36.0±4.0	61.1±9.0	-	-	-	48.5±2.8^{fg}
June 2000	23.7±2.7	67.8±9.5	-	-	-	45.8±2.8^{f}
June 2001	15.1±1.4	41.2±1.7	-	-	-	28.2±2.8^{de}
July 2000	19.5±2.3	37.8±3.9	25.1±3.6	11.0±1.6	29.2±5.3	24.5±1.8^{de}
July 2001	26.8±2.5	61.1±5.4	4.4±1.1	13.1±1.5	56.7±11.1	32.4±1.8^{e}
Aug.2000	5.6±0.5	9.5±1.4	4.3±0.7	5.7±1.2	13.2±1.3	7.7±1.8^{ab}
Aug.2001	34.7±7.2	39.1±9.5	5.1±0.8	17.3±2.2	35.2±7.0	26.3±1.8^{de}
Sept.2000	5.2±0.9	-	-	8.7±1.7	10.8±0.9	4.9±2.0^{a}
Sept.2001	15.5±2.9	22.4±2.3	10.4±1.1	12.4±1.2	18.4±2.3	15.8±1.8^{bc}
Oct. 2000	28.5±0.9	-	38.5±0.4	22.0±1.5	12.7±1.8	20.4±2.4^{cd}
Oct. 2001	4.3±0.5	9.3±1.3	9.7±1.4	6.6±1.6	6.3±0.7	7.2±2.0^{ab}
Areas' means[2]						
2000	21.5±1.9^{bcd}	31.5±1.6^{ef}	17.0±2.2^{abc}	11.8±2.2^{ab}	16.5±2.2^{abc}	
2001	22.1±1.6^{cd}	39.0±1.6^{f}	7.4±2.0^{a}	12.4±2.0^{a}	29.2±2.2^{de}	

[1] Different superscripts (a,b,c,d,e,f,g) within the column indicate significant differences (P<0.05)
[2] Different superscripts (a,b,c,d,e,f) within columns and rows indicate significant differences (P<0.05)

Table 5 – Horse Fodder Units (HFU/day/ha) referred to the pasture areas (Past. a. 1; Past. a. 2) and to the grazing meadow areas (Graz. m. a. 1; Graz. m. a. 2; Graz. m. a. 3) (mean values ± s.e.)

Date	Past.a.1	Past.a.2	Graz.m.a.1	Graz.m.a.2	Graz.m.a.3	months' means[1]
May 2000	32.1±3.7	55.0±3.6	-	-	-	43.5±1.9^{e}
May 2001	24.1±6.5	42.6±6.3	-	-	-	33.3±1.9^{d}
June 2000	16.4±1.9	47.4±6.7	-	-	-	31.9±1.9^{d}
June 2001	9.3±0.8	27.3±1.1	-	-	-	18.3±1.9^{c}
July 2000	13.6±1.6	25.4±2.6	13.2±1.9	5.9±0.9	17.7±3.2	15.2±1.2^{c}
July 2001	17.8±1.6	40.8±3.6	1.9±0.5	6.1±0.7	33.3±6.5	20.0±1.2^{c}
Aug.2000	3.9±0.3	6.7±1.0	2.5±0.4	3.8±0.8	9.2±0.9	5.2±1.2^{a}
Aug.2001	23.2±4.8	26.3±6.4	3.1±0.5	11.1±1.4	22.8±4.5	17.3±1.2^{c}
Sept.2000	3.4±0.3	-	-	6.0±1.2	7.5±0.6	3.4±1.3^{a}
Sept.2001	10.3±2.0	16.2±1.7	7.4±0.7	8.8±0.9	13.0±1.6	11.1±1.2^{bc}
Oct. 2000	21.3±0.7	-	29.7±0.3	16.6±1.1	9.4±1.3	15.4±1.6^{c}
Oct. 2001	3.0±0.4	7.2±1.0	7.0±1.0	4.6±1.1	4.5±0.5	5.2±1.3^{ab}
Areas' means[2]						
2000	15.1±1.2^{bc}	22.4±1.1^{de}	11.4±1.5^{ab}	8.1±1.5^{a}	11.0±1.5^{ab}	
2001	14.6±1.1^{bc}	26.7±1.1^{e}	4.8±1.3^{a}	7.7±1.3^{a}	18.4±1.5^{cd}	

[1] Different superscripts (a,b,c,d,e) within the column indicate significant differences (P<0.05)
[2] Different superscripts (a,b,c,d,e) within columns and rows indicate significant differences (P<0.05)

Table 6 – Dry Matter (DM) and Horse Fodder Units (HFU) requirements of the different classes of horses

Horses	n.	DM requirements		UFC requirements	
		kg/head/day	total kg/day	UFC/head/day	UFC/day
Barren mares	28	9.6	268.8	4.8	134.4
Pregnant mares (april-june)	112	10.8	1210	6.6	739.2
Lactating mares (july-august)	112	18	2016	10.8	1209.6
Lactating mares (sept.-october)	112	18	2016	10.8	1209.6
Young horses (1 to 2 years old)	30	12	360	7.2	216
Foals (4-6 months years old)	80	6	480	3.6	288

Table 7 – Dry Matter (DM) (kg/day) and Horse Fodder Units (HFU) (HFU/day) production vs. total nutrient requirements of the herds

		Daily Production	Daily Requirements	Difference
May 2000	DM	24069.34	1838.80	+ 22230.54
	UFC	17487.78	1089.60	+ 16398.18
May 2001	DM	19489.88	1838.80	+ 17651.08
	UFC	13409.36	1089.60	+ 12319.76
June 2000	DM	18798.05	1838.80	+ 16959.25
	UFC	13108.34	1089.60	+ 12018.74
June 2001	DM	11546.24	1838.80	+ 9707.44
	UFC	7532.77	1089.60	+ 6443.17
July 2000	DM	24277.28	2644.80	+ 21632.48
	UFC	15343.22	1560.00	+ 13783.22
July 2001	DM	24041.23	2644.80	+ 21396.43
	UFC	16381.12	1560.00	+ 14821.12
Aug.2000	DM	6150.46	2644.80	+ 3505.66
	UFC	4355.84	1560.00	+ 2795.84
Aug.2001	DM	20335.68	2644.80	+ 17690.88
	UFC	14199.37	1560.00	+ 12639.37
Sep. 2000	DM	2431.09	3124.80	- 693.71
	UFC	1872.15	1848.00	+ 24.15
Sep. 2001	DM	14069.76	3124.80	+ 10924.96
	UFC	10294.89	1848.00	+ 8446.89
Oct. 2000	DM	23281.69	3124.80	+ 20156.89
	UFC	18007.42	1848.00	+ 16159.42
Oct. 2001	DM	7825.65	3124.80	+ 4700.85
	UFC	5877.07	1848.00	+ 4029.07

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