Effect of grass height and species on nutritive value of winter stockpiled forage

Note P., Picard F., Pottier E.

in

Baumont R. (ed.), Carrère P. (ed.), Jouven M. (ed.), Lombardi G. (ed.), López-Francos A. (ed.), Martin B. (ed.), Peeters A. (ed.), Porqueddu C. (ed.).
Forage resources and ecosystem services provided by Mountain and Mediterranean grasslands and rangelands

Zaragoza : CIHEAM / INRA / FAO / VetAgro Sup Clermont-Ferrand / Montpellier SupAgro
Options Méditerranéennes : Série A. Séminaires Méditerranéens; n. 109

2014
pages 207-211

Effect of grass height and species on nutritive value of winter stockpiled forage

P. Note[1,*], F. Picard[2] and E. Pottier[3]

[1]Unité Expérimentale des Monts d'Auvergne – INRA, Les Razats 63820 Laqueuille (France)
[2]Unité Mixte de Recherche sur les Herbivores – INRA, Theix 63122 Saint Genes Champanelle (France)
[3]Institut de l'élevage – CIIRPO, site du Mourier 87800 Saint Priest Ligoure (France)
*e-mail: priscilla.note@clermont.inra.fr

Abstract. The necessity of reconciling control of production costs, improvement of food autonomy and work efficiency on livestock farms generates new questions today. An answer to this issue seems to be a better valuation of grass by increasing the share of grazing in the ration. The implementation of this practice requires the knowledge of grassland evolution along winter in terms of quality and quantity. To answer this issue, two forage collections have been established in two sites with different soil and climatic conditions in France. Two levels of stockpiling were studied on five grass covers (*Lolium perenne, Dactylis glomerata, Festuca rubra, F. arundinacea,* permanent grassland). Biomass and nutritional values were studied over winters of 2010/2011 and 2011/2012. An effect of grass species and height at the beginning of winter can be observed on dry-matter yield and pepsin-cellulase dry-matter digestibility. *L. perenne* and *F. rubra* maintain good nutritional values along winter but the accumulation is limited as compared to *D. glomerata*. A good compromise is obtained with *F. arundinacea*. Stockpiling with a younger grass allows to maintain correct nutritional values at the end of winter.

Keywords. Grassland – Winter – Nutritional values – Stockpiling.

Effets de la hauteur et de l'espèce végétale sur la valeur nutritive de l'herbe en hiver

Résumé. *La nécessité de concilier maîtrise des coûts de production, amélioration de l'autonomie alimentaire et efficacité du travail sur des exploitations d'élevage génère aujourd'hui de nouveaux questionnements. Une réponse à cette problématique semble être une meilleure valorisation de l'herbe en augmentant la part du pâturage dans la ration. La mise en œuvre de cette pratique et son insertion dans un système de production nécessite de connaitre l'évolution de la prairie au cours de l'hiver, en valeur et en quantité. Pour y répondre, deux collections fourragères ont été mises en place dans des contextes climatiques différents en France. Deux niveaux de stock d'herbe en début d'hiver ont été étudiés sur cinq types de couverts végétaux (ray grass, dactyle, fétuque élevée, fétuque rouge, prairie permanente). L'évolution de la biomasse et des valeurs nutritives a été étudiée sur deux hivers : 2010/2011 et 2011/2012. Des effets « espèce » et « hauteur » ont pu être observés sur la digestibilité à la pepsine cellulase.* Lolium perenne *et* Festuca rubra *maintiennent de bonnes valeurs nutritives tout au long des hivers mais l'accumulation de biomasse reste limitée contrairement au dactyle.* Festuca arundinacea *semble être une espèce qui offre un bon compromis entre valeur nutritive et accumulation. Des stocks sur pied avec une herbe plus jeune ont permis de garder des valeurs nutritives correctes à la fin de l'hiver.*

Mots-clés. *Prairie – Hiver – Valeurs nutritives – Stock sur pied.*

I – Introduction

The increase of suckling cow herd size, the necessity of reducing the feeding costs, and the improvement of the work efficiency raise the problem of practices simplification. Many studies focus on outdoor wintering either with daily hay or silage feeding (Pottier *et al.*, 2001) or with an extended grazing season (D'Hour *et al.*, 2000). Can stockpiled forage grass be an alternative to

animals during the winter season that could extend the grazing season? And can this technique decrease the area of harvested surfaces and quantities resulting in winter work simplification? This practice is not yet common in France but it has been used in North America for several years during winter and summer (Taylor and Templeton, 1976; Baron *et al*., 2005). An experiment on stockpiled forage grass utilization by grazing animals carried out at Laqueuille, France (1000 m a.s.l.) over two winters (Note *et al*., 2010) showed a mitigated fodder balance depending on climatic conditions. In order to optimize this practice, questions regarding the evolution of green grass quality and quantity (which are dependent on botanical composition of the grassland and climatic conditions) in winter season need to be answered. At the beginning of winter grazing, what grass height would enable a better utilization and enhancement of the grass? In summary, the goal is to study the behaviour of different grass species during winter in terms of quantity and quality according to the level of stockpiled forage.

II – Materials and methods

The study was carried out on two sites with different soil and climatic conditions in France: (i) Mourier (45°39'N, 01°17'E, 360 m a.s.l. – continental with oceanic influence – mean temperature 4.4°C and mean rainfall of 245 mm during the two studied winters from November to March, with 12 days of snow in February 2012); and (ii) Laqueuille (45°38'N, 02°44'E, 1000 m a.s.l. – mountain conditions – mean temperature 1,9°C and mean rainfall 339 mm – 35 days of snow between November 2010 and January 2011, 8 and 33 days of snow in December 2011, and between February and March 2012 respectively).

Two forage collections with the same design were implanted in May 2008 at Laqueuille and in October 2009 at Mourier. On three blocks (repetitions), we studied two factors with a randomized design: grass species and grass heights obtained in winter. Four commercial grassland species monocultures were studied on 9 m² plots: *Lolium perenne (LP), Dactylis glomerata (DA), Festuca rubra (FR)*, and *F. arundinacea (FA).* The Laqueuille site comprised a supplemental variant known as the local permanent grassland. At the beginning of both winters 2010/2011 and 2011/2012, two levels of stockpiled forage were constituted at each site: high (H) and medium (M) grass height at Laqueuille and medium (M) and low (L) grass height at Mourier. Stockpile initiation dates were: at Laqueuille, June 22 and July 29, 2010 and June 28 and August 2, 2011; at Mourier, July 16 and Septemer 20, 2010 and May 25 and September 14, 2011. Both experiments received a non-limiting N-P-K fertilisation.

The fresh harvested biomass was collected once a month from September/October to March then dried at 60°C for 72 h and weighed to calculate the DM yield of each plot (g DM m^{-2}) at each date. 744 samples were collected for DM yield at all cutting dates. These samples were ground using a 1 mm screen-mill. Each sample was analysed using near-infrared reflectance spectroscopy (NIRS) to determine its nutritive value. The calibration set was analysed, among other things, for pepsin-cellulase DM digestibility (Aufrère and Demarquilly, 1989). The statistical parameters of the calibration models obtained for pepsin-cellulase DM digestibility of the grass were: number of samples, 269; ranges, 20.7-90.4%; standard errors of cross-validation, 2.52%. The R^2 of cross-validation was 0.98.

A Shapiro-Wilk test was performed on residuals of studied model using R software. It showed that our data were not normally distributed. As a consequence, two non-parametric tests using R software were performed: a Wilcoxon test for linked data within each site (same date, block, site, specie or height modality) and a Mann-Whitney test in order to compare data between sites.

III – Results and discussion

On both winters, we observed a gradient of grass height and accumulation between sites which is coherent with our objectives (Fig. 1). In winter 2011/2012, the levels of biomass accumulation were clearly less important on Laqueuille because of a proliferation of voles which reduced by half the stock compared with winter 2010/2011. With the same stockpile initiation dates, we noticed that grass species showed different capacity of accumulation: *Dactylis glomerata* and *Festuca arundinacea* presented a stock approximately twice as large as other covers.

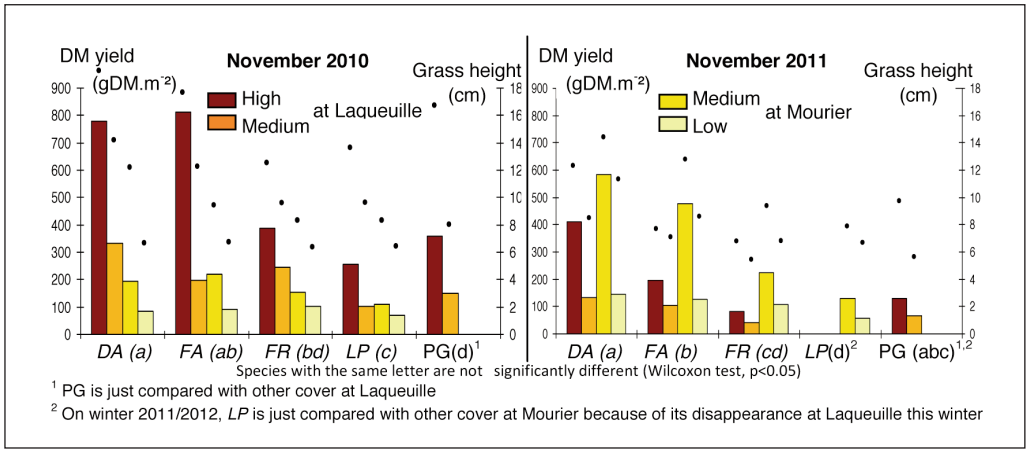

Fig. 1. Grass availability at the beginning of two winters in November at Laqueuille and Mourier (histogramm = DM yield, point = grass height).

The percentage of biomass disappearance during winter due to natural plant mortality (no grazing on forage collection) was calculated (Table 1). This variable was not studied on the second winter because of rodent impact. Depending on sites, we noticed a different relation between the modalities of grass height. At Mourier, low modality presented a low rate of disappearance and even a growth for *Festuca rubra* ($p<0.05$), whereas at Laqueuille, high modality seemed to be more "conservative" ($p<0.01$). Climate seemed to play an important role: under more frigid climate (e.g. Laqueuille), unlike short grass, important biomass would tend to protect grass from degradation. But under more moderated climates (Mourier), the grass age seemed to be the main factor of degradation. At Laqueuille, *Lolium perenne* distinguished itself from *Festuca rubra* and *Dactylis glomerata* ($p<0,05$). At Mourier, *Festuca rubra* distinguished itself from other species ($p<0.05$) but not from *Lolium perenne*.

Table 1. Average percentage of biomass disappearance on winter 2010/2011 on two sites (= [November biomass – February biomass]*100 / November biomass)

Site	Grass height	*DA*	*FA*	*FR*	*LP*	PG
Laqueuille	High	58.7	62.4	54.4	73.6	46.6
	Medium	65.7	75.1	80.1	100.0	97.3
Mourier	Medium	56.1	69.9	-38.8	27.9	–
	Low	37.2	4.2	-27.7	22.5	–

The lowest grass heights presented the highest pepsin-cellulase DM digestibility along winter: on average +9% at Laqueuille and +14% at Mourier (Wilcoxon test with same cut date, species and block: p<0.01). The same relation was found in November (the beginning of winter) and February (the end of winter) (Tables 2 and 3). Between November and February, digestibility decreased as expected (Tables 2 and 3) by 10% on average, but the evolution of digestibility was not statistically significant depending on height modalities. Between sites during both winters (Mann-Whitney test, p<0.01), the low height at Mourier presented the highest digestibility (mean: 67%) as compared to the medium height at Mourier, which showed 53% against 46% for the medium height at Laqueuille.

Along the winter on both sites, the species could be ranked as follows according to digestibility (Wilcoxon test with same cut date, height modality and block: p <0.05): *Lolium perenne* > *Festuca rubra* > *Festuca arundinacea* > permanent grassland> *Dactylis glomerata*. But at the end of winter, *Lolium perenne* and *Festuca rubra* didn't show any difference and the permanent grassland was not different from *Dactylis glomerata* and *Festuca arundinacea* (Table 2).

Table 2. Means of pepsin-cellulase dry-matter digestibility for five grass covers at Laqueuille and at Mourier at the beginning (November), middle (January) and end (February/March) of each winter

Grass height			**High**				**Medium**						
Species	***DA***	***FA***	***FR***	***LP***	**PG**	**Means**	***DA***	***FA***	***FR***	***LP***	**PG**	**Means**	**Means**
Laqueuille (2010/2011)													
Nov.	31.5	46.6	44.0	38.0	37.1	**39.5**	44.3	57.9	56.0	57.4	48.1	**52.7**	**46.1**
Jan.	24.6	29.3	32.8	27.8	26.4	**28.2**	33.6	34.0	39.5	37.8	30.9	**35.2**	**31.7**
Feb.	23.3	29.3	35.6	28.3	25.4	**28.4**	26.9	34.0	37.7	–	24.2	**32.0**	**29.8**
(2011/2012)													
Nov.	35.2	46.0	58.6	68.7	47.5	**49.9**	49.6	57.6	61.3	69.3	44.0	**56.3**	**53.3**
Jan.	25.6	32.5	47.5	59.8	34.7	**38.6**	35.1	41.8	50.7	57.4	47.6	**45.6**	**42.0**
Mar.†	24.8	40.3	51.6	–	32.4	**36.0**	40.7	44.9	52.6	59.7	41.0	**46.3**	**41.4**
Means	**27.5**	**37.3**	**44.6**	**41.5**	**33.9**	**36.6**	**38.4**	**45.0**	**49.6**	**55.6**	**40.7**	**45.4**	**40.9**
Mourier (2010/2011)													
Nov.	55.5	45.9	58.7	60.0	–	**55.0**	58.9	66.2	61.6	71.8	–	**64.7**	**59.8**
Jan.	49.5	44.1	65.1	69.0	–	**56.9**	61.7	63.2	69.2	73.5	–	**66.9**	**61.9**
Feb.	45.7	45.0	65.5	70.4	–	**56.7**	54.8	66.1	69.1	74.2	–	**65.3**	**60.8**
(2011/2012)													
Nov.	46.0	54.7	61.9	62.3	–	**56.2**	76.5	74.8	69.6	76.7	–	**74.4**	**65.3**
Jan.	30.0	36.0	54.4	66.7	–	**46.8**	62.7	59.8	65.0	68.6	–	**64.0**	**55.4**
Feb.	26.3	29.9	49.1	–	–	**35.1**	53.8	57.2	60.8	74.1	–	**59.0**	**47.7**
Means	**42.2**	**42.6**	**59.1**	**65.7**	–	**51.8**	**61.4**	**64.5**	**65.9**	**73.0**	–	**65.9**	**58.9**

† No measures in February 2012 at Laqueuille because of snow cover for the whole period.

IV – Conclusions

Stockpiling a younger grass allows to maintain correct nutritional values at the end of winter. It is thus necessary to have a low stocking rate (around 10 cm of grass height at the beginning of winter, but it depends on species) on large area to offer cattle or sheep a good grass quality over the winter period. Some species as *Festuca arundinacea* or *Festuca rubra* seem to be a good compromise between nutritional values and biomass accumulation.

Acknowledgments

The authors are grateful to the technical teams of IDELE-CIIRPO (Mourier) and INRA-UEMA (Laqueuille) for their works on forage collections, the team of INRA-UMRH-RAPA for their collaboration in the measurements of nutritive values and for the financial assistance received from CASDAR Salinov.

References

Aufrère J. and Demarquilly C., 1989. Predicting organic matter digestibility of forage by two pepsin-cellulase methods. In: *Proceedings of the 16th International Grassland Congress*, Nice, France, 2, p. 877-878.

Baron V.S., Campbell D., Myron B. and Grant L., 2005. Accumulation period for stockpiling perennial forages in the western Canadian prairie parkland. In: *Agron. J.*, 97, p. 1508-1514.

D'Hour P., Petit M. and Lassalas J., 2000. Allongement de la durée de pâturage et performances de vaches allaitantes. In: *Renc. Rech. Ruminants*, 7, p. 123-125.

Note P., Egal D., Castellan E. and D'Hour P., 2010. Utilisation hivernale d'un stock d'herbe sur pied par des bovines au pâturage. In : *Renc. Rech. Ruminants*, 17, p. 62.

Pottier E., D'Hour P., Havet A. and Pelletier P., 2001. Allongement de la saison de pâturage pour les troupeaux allaitants. In: *Fourrages*, 167, p. 287-310.

Taylor T.H. and Templeton Jr. W.C., 1976. Stockpiling Kentucky bluegrass and tall fescue forage for winter pasturage. In: *Agron. J.*, 68, p. 235-239.