Effects of distance and orientation of hedgerows on grass production and quality in permanent grasslands

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Abstract

Grass biomass production and quality were recorded in ungrazed paddocks located in Modave (Belgium) in order to study the influence of distance and orientation of hedgerows. The studied distances were 5, 10, 20 and 30 m from hedgerows. The paddocks were located to the East, West and South of the hedgerows. Biomass production and grass quality were measured twice: on July 11th and on August 9th. Weather conditions were favourable for grass growth during the first period (13 June –11 July) whereas the weather was dry during the second period (11 July–9 August). Biomass production was significantly higher during the first period compared to the second one (100.8±44.7 vs 27.8±15.8 g m^{-2}; P <0.001). East and West orientations allowed higher biomass production than the South orientation, P<0.05 irrespective of the period). During the second period, biomass increased progressively away from the hedgerows and become higher for East orientation at 20 m and 30 m compared to other orientations (P<0.01). Grass quality was affected by distances and orientations but remained high and sufficient to meet animal requirements. Our results show that hedgerows have influenced grass production, with different results depending on the orientation and growing conditions of the grass.

Keywords: agroforestry, grass biomass, grass quality, hedge, orientation, distance

Introduction

Agroforestry is encouraged in agroecological systems and allows farmers to benefit from CAP payments. However, some livestock farmers are reluctant to plant hedges despite the numerous advantages they offer (such as improvement of biodiversity, protection against erosion and against drying out, capacity to store carbon and contribution to offer forages and to improve animal welfare by offering them shelter). These farmers fear a reduction in grass production due to competition between the growth of the hedge and that of the meadow. The present trial aims to provide data related to the influence of hedges on grass production and quality.

Materials and methods

The trial was carried in Modave (Belgium), between 13 June and 9 August 2022 in 3 pastures grazed rotationally by dairy cows. Fences were erected in 6 paddocks along double hedges to protect grass from grazing. There were 2 paddocks by orientation: the hedgerows were located at East, West and South of the paddocks. Biomass production and grass quality were measured twice: on 11 July and 9 August at 5 plots per distance on each paddock. The grass was cut from a length of 2 meters in each plot. The width of the mower was 42 cm and the cut height was 5 cm. The grass was dried to obtain dry matter percentage. For the first period (cut), the grass swards were also sampled by hand plucking, with a sample was taken at each distance in each paddock, to provided samples for determination of chemical composition. The Dutch evaluation system was used to express energy content (VEM) and protein (digestible protein in the small intestine (DVE), rumen-degradable protein balance (OEB)). The grass composition in water soluble carbohydrate (WSCH) and crude protein (CP), crude fibre (CF), VEM, DVE, OEB in the

dry matter and digestibility were determined. The grass swards between the measured plots were also mown on 11 July to avoid shading which could have affected the grass growth as measured on 9 August. Statistical analyses were carried out with R4.2.2 ANOVA models, setup for biomass production and for grass chemical composition, considering orientation and distance as fixed effect. T tests, for data with normal distribution, Wilcoxon tests and Kruskal-Wallis tests for non-parametric set data, were used to compare the means.

Results and discussion

Weather conditions were favourable for grass growth during the first period whereas the weather was dry during the second period. Logically, grass biomass was significantly higher for cut 1 (100.8±44.7 vs 27.8±15.8 g m^{-2}; $P<0.001$). Grass biomass values are shown in Figure 1 for each cut date, orientation and distance. Orientation had a significant effect: East and West orientations allowed greater biomass production than the South one, probably due to conditions of growth with a better solar irradiation ($P<0.05$). Significant effects were observed between distance and orientation ($P<0.01$), and cut and orientation ($P<0.01$). For cut 1, with weather conditions favourable for grass growth, the south orientation biomass increased at further distance of hedgerows and were lower for each distance compared to other orientations. East orientation seems to favour grass growth overall at 20 m ($P<0.01$). Grass biomass at West were highest than other orientations at 5 m distance and remained constant until 20 m, and increased at 30 m to reach East biomass. At cut 2, for East orientation, biomass increased progressively away from the hedgerows and values were significantly higher at 20 m and 30 m compared to other orientations at the same distances ($P<0.01$). South orientation biomass values were the lowest at every distance, except at 5m where they were higher than other distances ($P<0.05$) and similar to the West orientation biomass at 5 m. At the opposite, for West orientations, biomass decreased away from the hedgerows to become similar to those of South orientation at the same distances (20 m and 30 m). Few data are available on this subject, but Van Vooren *et al.* (2018) and Heimsch *et al.* (2023) did not record a negative effect on hedgerow or tree row on winter wheat or oat crop beyond 2 metres. In our trial, we did not measure data under 5 metres because the grass at that distance had been trampled by the animals.

The grass chemical composition (cut 1) shows it was of good quality and compatible with the requirements of dairy cows (Table 1). The distances influenced CF content, which was significantly higher at 5 m than at 20 m and 30 m (211 g vs 196 g kg^{-1}; $P<0.05$). There was a tendency to have lower DVE value at 30 m compared to 10 m and 20 m ($P<0.10$). CF, WSCH, DVE, VEM and digestibility were lower for grass located East of the hedgerows ($P<0.05$). This could be attributed to a lower levels of the solar luminosity.

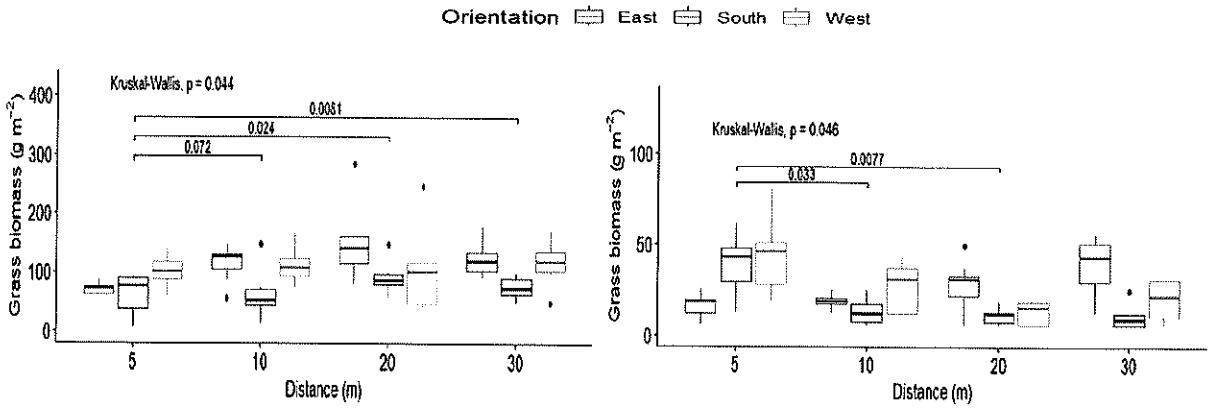

Figure 1. Grass biomass for each orientation and each distance of the hedgerows for cuts 1 and 2. For each cut, P-values are given for Kruskal-Wallis test and when there are significant differences between the distances.

Table 1. Grass chemical composition and feeding values at different orientation of the hedgerows (cut 1).

	Orientation of the hedgerow			SEM	*P* value
	East	West	South		
CP (g kg^{-1})	202.1	211.4	204.8	6.41	0.60
CF (g kg^{-1})	208.0^{b}	198.6^{a}	195.1^{a}	4.39	0.09
WSCH (g kg^{-1})	78.6^{a}	87.0^{ab}	97.1^{b}	8.60	0.31
DVE (g kg^{-1})	96.8^{a}	98.4^{ab}	99.4^{b}	1.10	0.12
OEB (g kg^{-1})	43.3	51.4	43.0	5.58	0.55
VEM	968.5^{a}	978.1^{ab}	992.9^{b}	6.17	0.06
Digestibility (%)	79.1^{b}	80.8^{a}	81.3^{a}	0.61	0.05

CP, crude protein; CF, crude fibre; WSCH, water soluble carbohydrate expressed in the dry matter; VEM, energy value; DVE,: digestible protein in the small intestine; OEB, dietary rumen-degradable protein balance.

Conclusion

The South orientation had a negative impact when the weather was favourable, probably due to the shading effect, but this can protect grass in warm and dry conditions. Hedgerows were unfavourable for grass growth at 10 m and 20 m, compared to 5 m, when the weather was dry. From these first results, it can be concluded that the hedgerows influenced grass production but with different results depending on the orientation and growing conditions of the grass. Grass quality was high and sufficient to meet animal requirements, regardless of the distance from the hedgerow and the orientation. However, at East orientation grass quality seems to be lower.

References

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