Light Interception and Dry Matter Yield in Grass/Legume Mixtures

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Abstract

The influence of grass variety on light interception and dry matter yield in a grass/clover mixture was studied. Two varieties of timothy (*Phleum pratense L.*) and five varieties of ryegrass (*Lolium spp*) as components in a mixture were compared during the spring period up to the first cut of the third harvest year. By replacing the timothy variety in the mixture both light interception and dry matter yield were significantly affected. The leaf orientation was thought to be a contributing factor with erect leaves intercepting less light. There were no significant differences neither in light interception nor in yield between the mixtures with different ryegrass varieties, not even between the earliest and the latest varieties being the two contrasts in light interception.

Keywords: Light interception, grass/clover mixture, timothy, ryegrass, dry matter yield.

Introduction

Many papers have been published on light interception in agricultural crops. But few have dealt with the variation among varieties of a single species in this character and still fewer have covered the light interception of different forage grasses. In the present work the influence of grass variety on light interception and yield of a grass-clover mixture has been studied in a trial sown in 1989.

Material and Methods

The entries involved were sown as part of a mixture of 20 % red clover (*Trifolium pratense L.*), 30 % timothy (*Phleum pratense L.*), 30 % meadow fescue (*Festuca pratensis Huds.*) and 20 % ryegrass (*Lolium spp L.*). Two timothy varieties alternated as well as five ryegrass varieties. There were two replications of each entry, which means that each timothy variety appeared in 10 plots and each ryegrass variety in 4 plots.

The timothies were: the old and well-known variety Kämpe II which is quite variable in most characters, and the newer variety Carola with more erect, narrower leaves.

The ryegrasses represented were: Viris, an old, early, diploid perennial ryegrass (*Lolium perenne L.*) with an early start in spring; Tove, an early, tetraploid perennial ryegrass, also with an early start; Leia, a later, tetraploid with a slow start; Lorry, a tetraploid hybrid ryegrass (*Lolium x boucheanum Kunth*); and Terry, a medium early, tetraploid perennial ryegrass.

The radiation measurements were made in the third harvest year, in 1992. They were made with a Sunfleck Ceptometer type CEP from Delta-T Devices Ltd. The first recording was made on May 7th, soon after commencement of growth, and the measurements were made every 2-3 days (in total 11 times) untill the first green matter harvest was made on June 3rd.

The solar radiation was measured horizontally, alternating above and below vegetation. In each plot, measurements were made between each of the 10 rows, i.e. 9 recordings were made above and 9 below vegetation. The intercepted or absorbed light was defined as the incident radiation minus the radiation transmitted through vegetation ($PAR_a = PAR_i - PAR_t$, according to the designations of Gosse et al., 1986). Light reflection from the ground (PAR_{tr}) or from the vegetation itself (PAR_r) was not considered, as being of minor importance. The measurements of intercepted light in the mixtures with specified timothy and ryegrass varieties are shown in diagrams 1 and 2, respectively.

Results

The solar radiation increased considerably from measurement No.1 to 2 and 3 but was then fairly constant over the test period. The measured radiation below the vegetation increased also from the first to the second recording but decreased then as a consequence of a gradually denser leaf mass. Only during the last measurements the radiation below vegetation again increased when the leaves slowly started to wilt. The harvest was made one day after heading of the latest timothy in the mixtures.

The average dry matter yield was 3520 kg/ha in mixtures with timothy Carola and 4030 kg/ha in the Kämpe II mixtures. The mixture dry matter yields as affected by the ryegrass component varied between 3560 kg/ha and 4110 kg/ha.

The correlation between intercepted light and dry matter yield varied between measurements, starting low on the first day, increasing up to measurements 4 and 5 where the correlation was significant, and then decreasing again to a low level at the last recording. On an average the correlation amounted to 0.61 where the level of significance was 0.63 for $p = 0.05$ and $n = 10$.

The analysis of variance of light interception (not reported) showed that there were highly significant differences both between measurements and between seed mixtures. Among the mixtures there was a significant difference between the two timothy varieties whereas the variation among ryegrass varieties did not quite reach significance.

The light interception in mixtures with the two timothies is shown in diagram 1. The variety Kämpe II captured more light during the whole period but the difference is more pronounced in the early part.

Out of the ryegrasses, the early Tove and the late Leia are shown in diagram 2. They reacted similar to the two timothies. The early Tove was clearly superior to the late Leia during the first measurements, but in the later part of the period they were more equal.

Discussion

Grass-clover mixtures have been studied among others by Faurie et al. (1996), but they compared mainly the grass versus the clover component and the effects of nitrogen fertilization. The radiation use efficiency of white clover was found to be lower than that of perennial ryegrass, but only one variety of each species was used. In the present work the effect of the clover component was not evaluated. Madakadze et al. (1998) compared the light transmission in a number of switchgrass varieties and found that early varieties had a higher PAR_t value in a late development stage. This is in agreement with our results where the PAR_t increased slightly during the two last measurements. Bélanger & Richards (1995) found very small differences in intercepted PAR among seven timothy varieties and concluded that the variation in radiation use efficiency is greater than the variation in light interception. In contrast, the difference between the two timothies in this study was significant in both light interception and yield. The mixture including Kämpe II was superior to Carola in light interception, probably because of the heterogeneous leaf orientation of Kämpe II compared to Carola's more homogeneously erect leaves. The two ryegrasses in diagram 2 showed a similar reaction. The mixture with the early Tove with its early start of growth absorbed more radiation during the test period and was superior in dry matter yield. The difference was, however, not significant, neither in light interception nor in dry matter yield.

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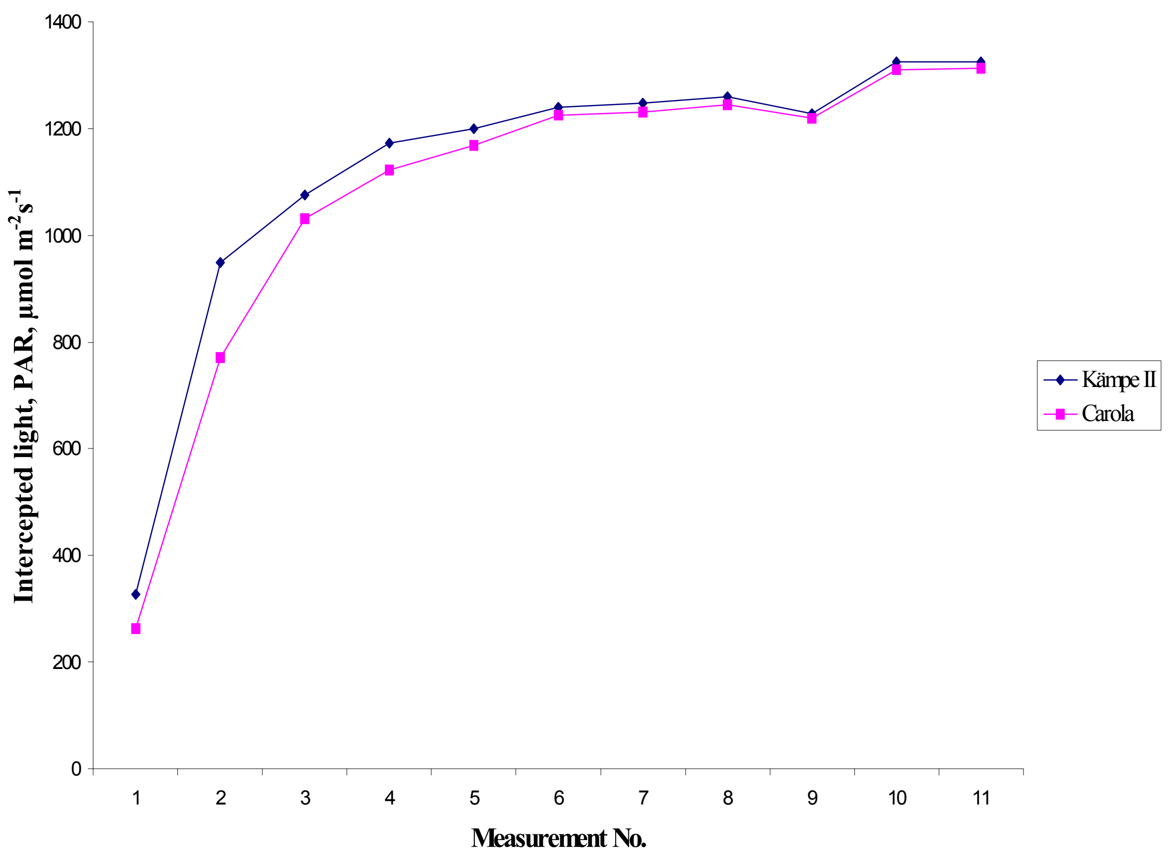

Figure 1 – Light interception in mixtures including the two timothy varieties.

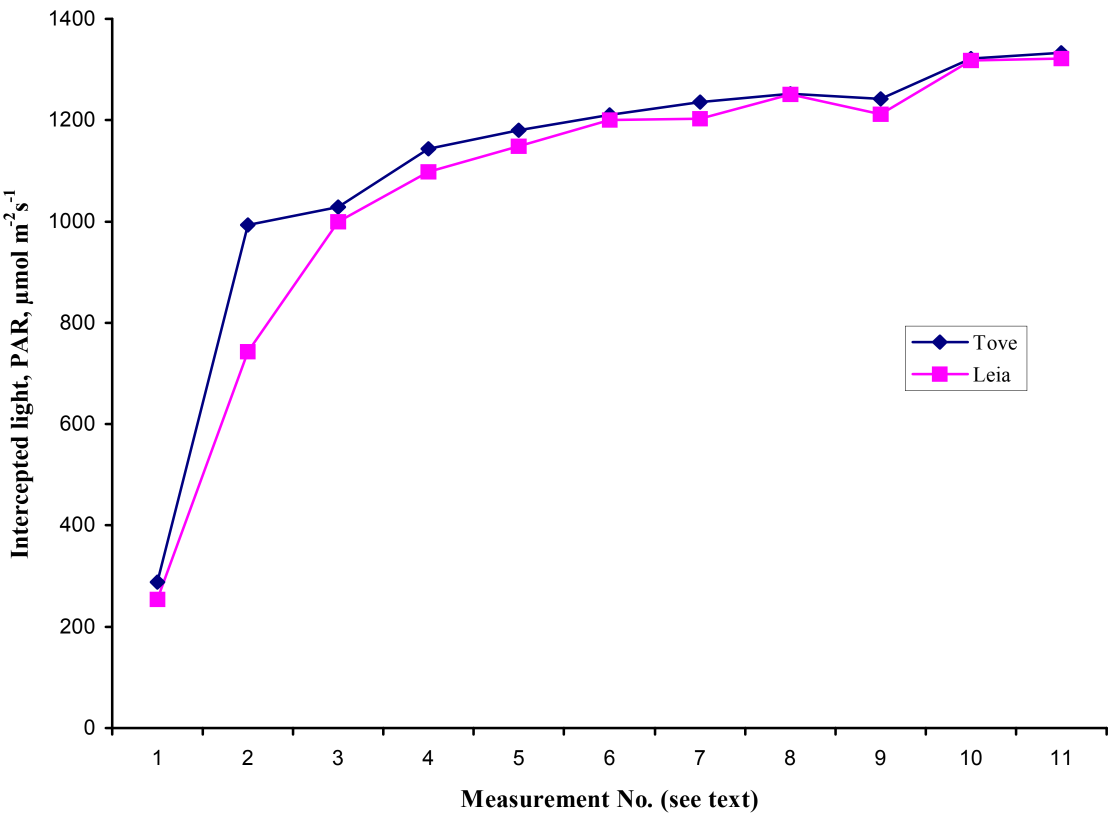

Figure 2 - Light interception in mixtures including one of two perennial ryegrasses.