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**REGROWTH, PRODUCTIVITY AND SYMBIOTIC NITROGEN FIXATION OF WHITE CLOVER (*TRIFOLIUM REPENS* L.) MONOCULTURES AND WHITE CLOVER RYEGRASS (*LOLIUM PERENNE* L.) MIXED SWARDS AT TWO CUTTING HEIGHTS.**

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## 2. SUMMARY

The aim of this study was to investigate whether regrowth, productivity and symbiotic nitrogen fixation are limited by repeated defoliations. For this purpose, the effects of two cutting heights (4 and 10 cm above ground level, presumably resulting in different residual leaf area) on regrowth, productivity and symbiotic nitrogen fixation of white clover swards under field conditions was investigated. A comparison of clover monocultures and clover-ryegrass (*Lolium perenne* L.) mixtures was made in order to understand the behaviour of clover when grown with a companion grass. There were six harvests per year and the swards were fertilized with  $3 \text{ g N}\cdot\text{m}^{-2}\cdot\text{cut}^{-1}$  (equivalent to  $30 \text{ kg N}\cdot\text{ha}^{-1}\cdot\text{cut}^{-1}$ ). Of that amount, 1.6% to 2%  $^{15}\text{N}$  was incorporated. After each harvest, the residual clover leaf area index, yield parameters and symbiotic nitrogen fixation (isotope dilution technique) were determined. At periodic harvests, regrowth of leaf area, stolon morphological parameters and starch contents of clover stolons were determined.

After sowing in previous summer, the cutting height in the first production year (1990) had no influence on the regrowth of clover. The clover monocultures and clover-grass mixtures, cut at a height of 4 cm produced higher annual clover dry matter yields during both years; During the second year (1991) the effect was significant in the clover monocultures. The increase in the annual clover dry matter yields during the second production year is a consequence of 4 cm cutting height which increased the number of leaf bearing nodes and the number of growing points. The increased growth of grass in the clover-grass mixtures, cut at 10 cm height during the second production year, had a negative effect on the proportion of clover. In the field the most predictable response of clover to a lower cutting height (4 cm) would be an increase in the number of growing points. The relative response of clover and grass in mixture is also important in this respect.

During both production years, white clover grown in mixture with grass had

significantly higher percentages of nitrogen from symbiotic fixation as compared to clover grown in monocultures. The annual clover nitrogen yields derived from symbiosis were closely related to the proportion of clover in the harvested herbage. During the second production year, the nitrogen apparently transferred from clover to grass accounted for about one fourth of the total nitrogen harvested from grass. The governing element of symbiotic nitrogen fixation in the field is white clover's demand (sink) for symbiotically fixed nitrogen. This parameter is greatly affected by the availability of mineral nitrogen or the competition through associate non-legume plants. Therefore, it can be concluded that symbiotic nitrogen fixation did not limiting clover growth.

## ZUSAMMENFASSUNG

Das Ziel dieses Feldversuches war es zu untersuchen, ob Wiederaustrieb, Ertragsfähigkeit und biologische Stickstoff-Fixierung limitierende Faktoren nach wiederholter Entblätterung darstellen. Zu diesem Zweck wurde der Einfluss von zwei Schnitthöhen (4 und 10 cm über dem Grund, die vermutlich zu zwei verschiedenen Restblattflächen führten) auf Wiederaustrieb, Ertragsfähigkeit und biologische Stickstoff-Fixierung untersucht. Der Vergleich von Weissklee-Reinbeständen und Weissklee-Gras-Mischungen wurde angestellt, um das Verhalten von Weissklee mit einem Begleitgras zu verstehen. Es erfolgten sechs Ernten pro Jahr mit je einer anschliessenden Düngung von mit  $3 \text{ g N m}^{-2}$  und Schnitt ( $30 \text{ kg N ha}$  und Schnitt). Diese Gaben bestand zu 1.6% bis 2% aus  $^{15}\text{N}$ . Nach jeder Ernte wurden Restblattflächenindex, Ertragsparameter und biologische Stickstoff-Fixierung (Isotopen Verdünnungstechnik) bestimmt. In periodischen Ernten erfolgte die Untersuchung von Blattneubildung, morphologische Parameter und Stärkegehalte der Weisskleestolonien.

Im ersten Hauptversuchsjahr beeinflusste die Schnitthöhe den Wiederaustrieb von Weissklee nicht. Die Weissklee-Reinbestände und die Weissklee-Raigras-Mischungen ergaben bei 4 cm Schnitthöhe beide Jahren höhere jährliche Klee-Trockensubstanzerträge, in zweiten Jahr war dieser Effekt nur in den Weissklee-Reinbeständen signifikant. Das Ansteigen der jährlichen Trockensubstanzerträge von Klee im zweiten Hauptversuchsjahr war eine Folge der 4 cm Schnitthöhe, welche die Anzahl blattbildender Nodien und Vegetationspunkte erhöhte. Das erhöhte Graswachstum in der Klee-Gras-Mischung bei Schnitthöhe 10 cm beeinflusste im zweiten Hauptversuchsjahr den Kleeanteil negativ. Die Schnitthöhe hatte keinen Einfluss auf den Wiederaustrieb von Weissklee. Im weiteren wurde beobachtet, dass unter Feldbedingungen die deutlichste Reaktion von Weissklee auf eine tiefere Schnitthöhe (4 cm) eine Erhöhung der Anzahl Vegetationspunkte war. In der Weissklee-Raigras-Mischung beeinflusste das relative Verhalten von Klee und Gras diese Grösse ebenfalls.

In beiden Hauptversuchsjahren wies Weissklee in der Mischung mit Raigras im Vergleich zum Weissklee-Reinbestand einen signifikant höheren Anteil an Stickstoff aus der biologischen Fixierung auf. Die jährlichen Stickstoffträge aus der Fixierung waren eng korreliert mit dem Weissklee-Anteil im geernteten Pflanzenmaterial. Im zweiten Hauptversuchsjahr betrug der Anteil des Stickstoffs, der vom Klee zum Gras transferiert wurde, ungefähr ein Viertel des im Graserntegut enthaltenen Stickstoffs. Das bestimmende Element für biologische Stickstofffixierung im Feld ist der Bedarf der Weissklees nach Stickstoff. Dieser Parameter ist stark beeinflusst von der Verfügbarkeit an mineralischem Stickstoff oder der Konkurrenz durch begleitende Nichtleguminosen. Daraus folgerten wir, dass die biologische Stickstoff-Fixierung von Weissklee den Nachwuchs nicht beeinflusste.

### 3. REGROWTH AND PRODUCTIVITY OF WHITE CLOVER (*TRIFOLIUM REPENS* L.) MONOCULTURES AND WHITE CLOVER-PERENNIAL RYEGRASS (*LOLIUM PERENNE* L.) MIXED SWARDS AT TWO CUTTING HEIGHTS.

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#### 1 ABSTRACT

In this study, the effect of cutting height (4 and 10 cm above-ground) on the regrowth and productivity of white clover was investigated under field conditions. A two year experiment (1990/1991) was conducted in Eschikon, Switzerland with white clover (*Lolium perenne* L. cv "Ladino") monocultures, white clover-perennial ryegrass (*Lolium perenne* L. cv "Bastion") mixtures and perennial ryegrass monocultures. The comparison of white clover monocultures and clover grass mixtures was made in order to understand the response of clover when grown in mixture with grass. Six harvests were made at four-week intervals. At each harvest, swards were fertilized with  $3 \text{ g N}\cdot\text{m}^{-2}$  ( $30 \text{ kg N}\cdot\text{ha}^{-1}\cdot\text{cut}^{-1}$  and  $180 \text{ kg N}\cdot\text{ha}^{-1}\cdot\text{a}^{-1}$ ). After each harvest, the residual clover leaf area index was determined. At periodic harvests, regrowth of leaf area and stolon morphological parameters, such as number of leaf bearing nodes, stolon length and the number of growing points of clover plants, were determined.

During the first production year, the cutting height showed no effect on the regrowth of clover. After cutting, clover grew faster when cut at 4 cm as compared to 10 cm. Clover monocultures, cut at a height of 4 cm produced a higher annual clover dry matter yield as compared to a cutting height 10 cm during both production years. This effect was apparent during the first year but significant only during second production year. Clover grown in clover-grass mixtures also had a higher dry matter yield when cut to 4 cm as compared with 10 cm in both years, but the differences were not significant. This may be due to the change in growth habit of clover when grown in association with grass. The increase in dry matter yields at a 4 cm cutting height during the second year in clover monocultures and in clover grass mixtures was due not only to the

positive effects of cutting height but was possibly a consequence of increase in both clover leaf bearing nodes and number of growing points. The annual total dry matter yields of clover-grass mixtures were higher than that of the annual clover dry matter yields of clover monocultures. During the second year, grass growth increased in the clover-grass mixtures cut at a height of 10 cm. This had a negative effect on the proportion of clover in the mixture.

The two cutting heights had no effect on the regrowth of clover after defoliation. Regrowth of clover was mainly governed by the increased leaf area index, thereby increasing the current photosynthesis. However, the effect of the cutting height on the number of clover growing points in both clover monocultures and in clover-grass mixtures as well as the competition by grass in the mixtures were more important than the direct effects of the two cutting treatments on the growth of clover.