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**FACTORS INFLUENCING THE YIELD PROPORTIONS OF *PLANTAGO*
LANCEOLATA L. AND *TARAXACUM OFFICINALE* WEB. IN *LOLIUM PERENNE* L.
SWARDS**

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Abstract

Diaspores of *Plantago lanceolata* and *Taraxacum officinale* respectively were sown in established *Lolium perenne* swards to determine the dynamics of their yield proportions during five years. The experimental factors were forb species, variety of the grass species (= early or late flowering), N-fertilization, and sward density. The amount of nitrogen fertilizer had the most important effect on yield proportions of the forb species and also on the total dry-matter (= DM) yield. The single creation of gaps in grass swards before sowing forbs had a lasting positive effect on the *Plantago lanceolata* and *Taraxacum officinale* proportions. Peak proportions of *Taraxacum officinale* in May were reduced when it was accompanied by the early flowering *Lolium perenne* variety. In contrast to *Taraxacum officinale*, until 1996 *Plantago lanceolata* had high yield proportions even when 80 kg N ha⁻¹ a⁻¹ was applied. This situation was not persistent, since the proportions of *Plantago lanceolata* in plots with high N amounts decreased rapidly in the following years.

Keywords: Pasture forbs, yield proportions, competition, sward density, N fertilization, grass variety

Introduction

Many grassland forb species, such as *Plantago lanceolata* and *Taraxacum officinale* (Isselstein 1994), have a high nutritive value. However, too high yield proportions of these forbs in pastures may be critical for the reason that their growth in rosettes might reduce space for grasses and in this way the biomass production. Furthermore, high amounts of these species may be unhealthy for grazing animals. Proportions over 30% of *Taraxacum officinale* may cause diarrhea and drop in animal performance (Stählin 1971). The establishment of forbs in grass swards is determined by inter-specific competition by grass species. Possible measures to control the plant interactions to a certain extent may be: choice of seeds (early/late development, stocking rate), fertilization, and cultivation measures to improve turf quality.

Material and Methods

In a field experiment the development of the yield proportion of *Taraxacum officinale* and *Plantago lanceolata* in *Lolium perenne* swards under varying conditions was examined during five years. The location was near Giessen to the north of Frankfurt/Germany with an annual rainfall of 653 mm and an average temperature of 9.1°C. The soil is a Stagnic Luvisol at pH 6.0. The experimental design was a latin square with four replications including the factors forb species, variety of *Lolium perenne* (= early flowering LIPRIOR, late flowering BAREZANE), N-fertilization (= 20 and 80 kg N ha⁻¹ a⁻¹) and sward density. Sward density of the grass was varied by creating artificial gaps before sowing the forbs. A gap size of 20 cm in diameter was realized by single application of herbicide on 30% of space of the treated plots. 1000 diaspores per m⁻² of *Taraxacum officinale* or *Plantago lanceolata* respectively were sown into established pure stands of *Lolium perenne* (sown in August 1992). The herbage was harvested four times per year (May = 1, June = 2, July/August = 3 and September/October =

4). During the first years of investigation the yield proportions were measured by cutting and weighing out forb and grass species separately. Later the yield proportions were determined visually, because this method showed a good correspondence to measurement.

Results and Discussion

The amount of N fertilizer was significant and the most important source of variance of yield proportions of both species at any time. Especially the yield proportions of *Taraxacum officinale* were clearly reduced when 80 kg N ha⁻¹ was applied (Figure 1), although this species is typical on soils with high nutrient level. The yield proportion of *Taraxacum officinale* was on its peak in BAREZANE swards before the first cut of the years 1995-1997. This *Lolium perenne* variety was only at the stage of shooting while *Taraxacum officinale* was already in full bloom. The early variety LIPRIOR prevented an extreme rise in population of the forb by coming into ear at the bloom stage of *Taraxacum officinale*. Apparently, this variety was able to compete more successfully with this forb species. In 60% of the harvests, the yield proportions of *Taraxacum officinale* were significantly higher in swards with BAREZANE than in swards with LIPRIOR.

The creation of gaps before sowing the forb species had a significant lasting effect on the yield proportions of *Taraxacum officinale* until end of 1996. Probably, the effect of the reduced sward density would be even more distinct by continuous disturbance of the swards. Previous investigations of Hofmann et al. (1997) showed that establishment of *Taraxacum officinale* and *Plantago lanceolata* after spreading the diaspores and survivorship of seedlings is promoted by gaps in grass swards, whereas higher N-amounts reduces vegetative and generative growth of both forb species.

The yield proportions of *Plantago lanceolata* (Figure 2) increased until May or June 1996 respectively up to 95% at low nitrogen level and more than 80% at 80 kg N ha⁻¹. In spite of high proportions of the forb species in 1996, the total annual yield of the better fertilized

swards with *Plantago lanceolata*, averaging more than 10 t DM a⁻¹, were comparatively high. The non-fertilized plots, averaging less than 5 t DM a⁻¹, were significantly less productive. In all, the DM yields in the other years were higher. The maximum yield was measured in 1995 when the DM production in swards with *Plantago lanceolata* fertilized with 80 kg N ha⁻¹ was on average 16 t DM ha⁻¹. Concerning the total yield, the N-fertilization was always the dominant source of variation. The yields of plots with *Plantago lanceolata* were mostly significantly higher than the yields of swards with *Taraxacum officinale*, although the yield proportions of *Taraxacum officinale* in the better fertilized plots were minimal most of the time.

Since 1996 the yield proportions of *Plantago lanceolata* decreased, especially in swards with higher N application rate. At the end of the investigations the yield proportion in these swards was 1-11%. Apparently, the high productivity of *Plantago lanceolata* in sufficiently fertilized *Lolium perenne* swards is limited in time. The factor sward density was significant for the yield proportions of *Plantago lanceolata* until May 1996; the factor grass variety was mostly insignificant.

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Figures

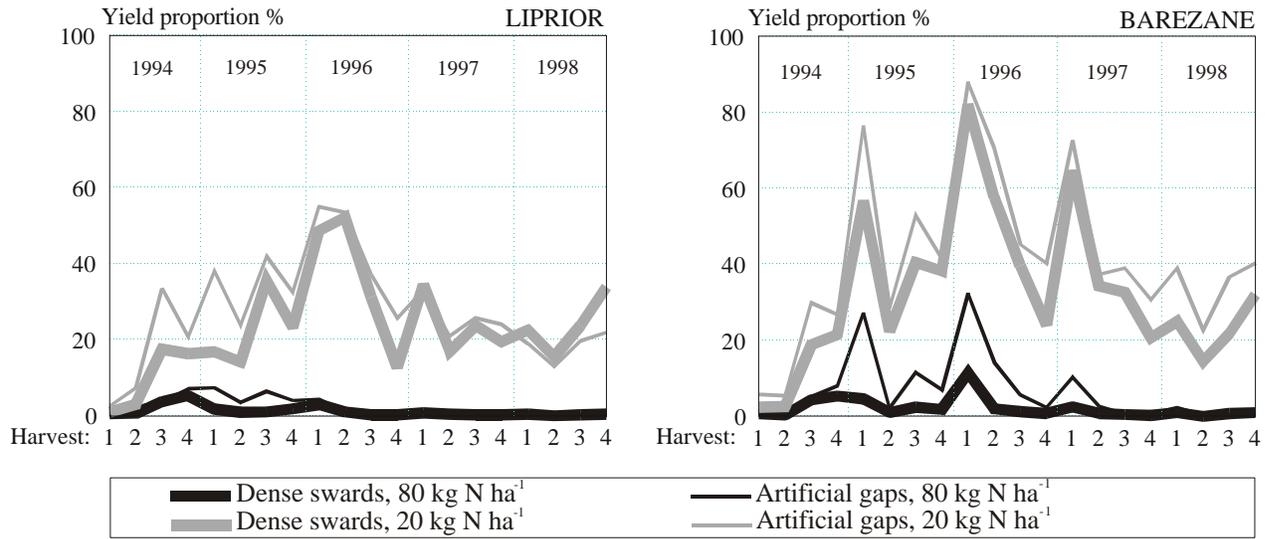


Figure 1 - Effect of N-fertilization, sward density and *Lolium perenne* variety on the yield proportions of *Taraxacum officinale*.

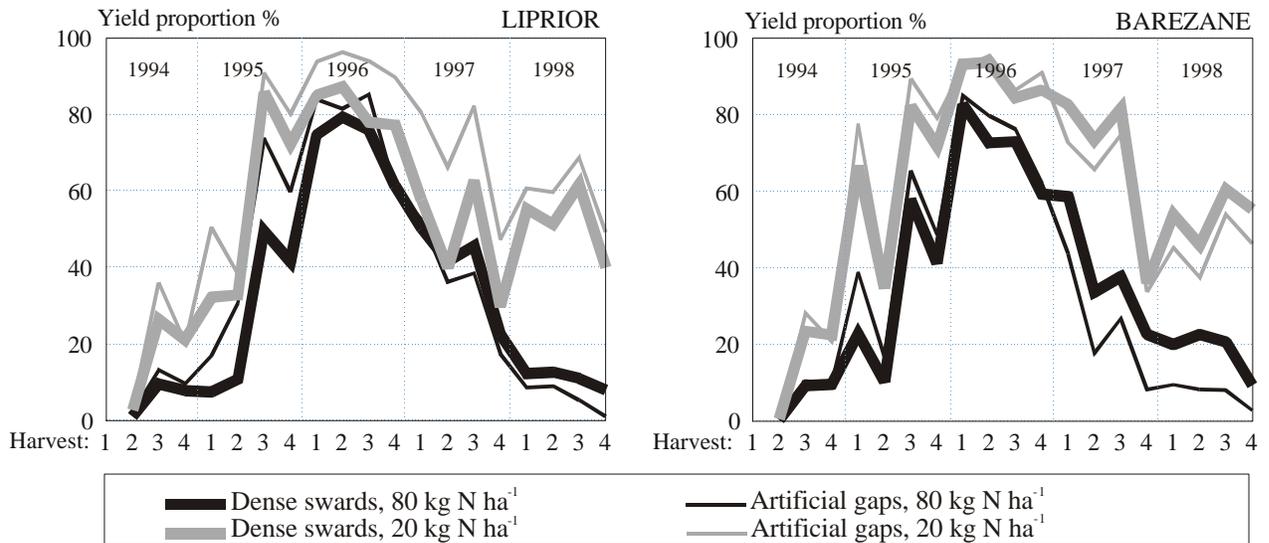


Figure 2 - Effect of N-fertilization, sward density and *Lolium perenne* variety on the yield proportions of *Plantago lanceolata*.