BIOMASS PARTITIONING IN GRASSES SUBJECTED TO DEFOLIATION

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ABSTRACT
Containerized plants of Perennial wild barley (*Hordeum bulbosum*) grown from corms and of Wild emmer wheat (*Tritium diccocoides*) grown from seeds, were grown in environmental conditions comparable to those encountered under field conditions. Both species were subjected to 3 defoliation frequencies (once, twice and three times during the season) each at 3 different clipping heights (1, 2.5 and 5 cm above ground level) plus a control treatment (10 treatments in all).

Wild emmer wheat control plants had significantly higher cumulative total and reproductive biomass over all harvests than all clipped plants. Clipping height and frequency had no significant effect on cumulative vegetative biomass. Increased clipping frequency strongly reduced reproductive biomass and plants clipped at a height of 5 cm had a significantly larger reproductive biomass than plants clipped at 1 cm. In Wild perennial barley plants both the cumulative total and the reproductive biomass decreased significantly at low clipping height, and decreased with clipping frequency. Values of both parameters were lower in all clipped plants than in control plants. The cumulative vegetative biomass was not markedly affected either by clipping height or by frequency of clipping, only the most severely clipped plants having values lower than control plants.

KEYWORDS
defoliation, *Hordeum bulbosum, Tritium diccocoides*, partitioning, clipping

INTRODUCTION
Management practices that initiate forage production earlier in the season or extend the growth period can significantly increase production efficiency of range forage species. Forage production under grazing are normally constrained by environmental limitations that are beyond management control but manipulation of biomass partitioning can improve forage quality and increase production efficiency. Numerous biotic and abiotic factors influence partitioning between vegetative and reproductive plant organs (Abrahamson, 1980), but competition or plant density and grazing are perhaps the two most important considerations under managerial control. Grazing reduces allocation to reproductive structures by removing the rudimentary inflorescences or reducing photosynthetic surfaces, and availability of phothosinthate (Hill and Watkin, 1975; Caldwell et al., 1981; Butler and Briske, 1988). Grazing also influences sexual reproduction by influencing tiller density and age class distribution. Lenient grazing early in the season can increase the number of tillers which may potentially become reproductive later in the year (Knight, 1970). However, if grazing becomes too severe or continues too late into the season, the number of reproductive tillers will diminish.

Even though several plant growth models have been constructed and validated, they do not adequately simulate biomass partitioning in variable environments and management systems (Coughenour et al., 1984; Johnson and Parsons, 1985; Brown et al., 1986; Bachelet et al., 1989).

The following experiment was conducted to study biomass partitioning under different defolitation regimes in two Mediterranean grasses Perenial wild barley (*Hordeum bulbosum*), a common perennial species and Wild emmer wheat (*Triticum dicoccoides*) an annual grass.

METHODS
Perenial barley corms and wild wheat seeds were collected from mixed annual-perennial grasslands in the Karei-Deshe experimental range, Galilee, Israel. The Barley regenerates annually and reproduces asexually from corms just below the surface, but also produces abundant seeds in certain conditions. It is a major dominant in ungrazed conditions and under a wide range of grazing pressures. Wild emmer wheat is a tall, large-seeded annual grass which is abundant and locally dominant in lightly grazed areas. Both species were subjected to 3 defoliation frequencies (once, twice and three times during the season) each at 3 different clipping heights (1, 2.5 and 5 cm above ground level) plus a control treatment (10 treatments in all). These clipping treatments simulate grazing at various intensities and schedules. Each treatment was replicated 10 times for each species. The experimental unit was 50 liter plastic containers, 40 cm deep, filled with local top soil (basaltic grumosol) in which 15 plants of wheat or barley were grown from seeds of corms. The plants were planted in the containers in November after the first rain. The harvested material from each container at each clipping was separated into leaves, streams, inflorescences and at the final clipping, also stems and corms. The corms were dug out of the ground after the last harvest, cleaned from soil and then treated as the other plant parts.. The separated material was dried at 65°C for 48 hours and weighed with 0.1 gram precision.

RESULTS
A) Wild emmer wheat: The cumulative total biomasss in the control treatment was significantly higher than in all clipped treatments (Fig. 1). The vegetative component of the biomass was similar in control plants to those of the clipped plants, but the reproductive biomass in the control plants was nearly three times as much as that in the most leniently clipped plants within clipped treatments. Clipping height had no significant effect on the total biomass but plants clipped once had a significantly higher total biomass than plants clipped more frequently. Increased clipping frequency caused significant reduction of cumulative vegetative biomass. Plants clipped at 5 cm had significantly larger reproductive biomass than plants clipped at the lower height. The reproductive fraction (reproductive / total biomass) was not affected by the clipping frequency but was significantly lower in plants clipped at 1 cm. Control plants had almost twice the reproductive fraction than plants clipped at 5 cm.

B) Wild perennial barley: The reproductive biomass in the control was significantly higher than plants in almost all clipped treatments. The cumulative total biomass, the reproductive biomass (including spikes and corms) and the reproductive fraction over all harvests were significantly lower at the 1 cm clipping height than at 5 cm and at 1 cm clipping height they were significantly lower at the highest clipping frequency (Fig. 2). The cumulative vegetative biomass was affected much less by both clipping height or frequency and only the most severely clipped plants (frequency 3, height 1 cm) had values significantly lower than control plants.

DISCUSSION

For both Wild emmer wheat and Wild perennial barley clipping greatly reduced the reproductive capacity of the plants but had only a small effect on the cumulative vegetative biomass of the plants. Both the clipping height and clipping frequency influenced reproductive and total production (Butler and Briske, 1988). These data suggested that controlled grazing during the growing season that induces multiple defoliation of the plants can improve leaf content of the sward with little reduction in leaf production (Knight, 1970). The long term effect of the reduction in reproductive capacity on plant regeneration is a cost that must be evaluated in separate studies. In a field study on Wild emmer wheat it was found that grazing of plants in the last month of the growing season caused a strong reduction in seed production, while grazing during the early and main vegetative period had little or no effect. (Noy Meir and Briske, 1996).

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Figure 1
Wild Emmer Wheat
Accumulative vegetative and reproductive biomas at two clipping heights and three clipping frequencies

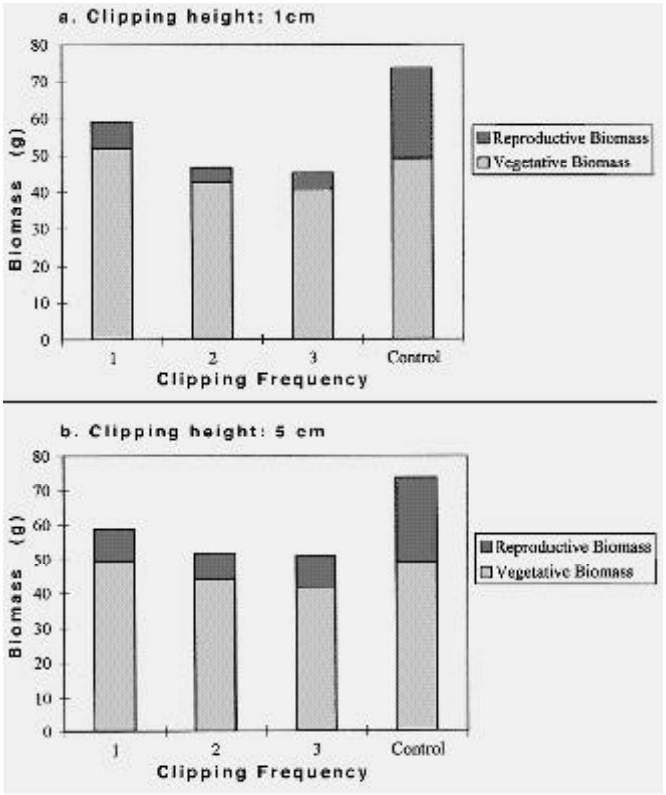

Figure 2
Wild Perennial Barley
Accumulative vegetative and reproductive biomas at two clipping heights and three clipping frequencies