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GROWTH OF ROOTS AND RHIZOMES IN TWO DESERT GRASSES AS INFLUENCED BY DEFOLIATION STRESS AND NITROGEN APPLICATION

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ABSTRACT

The growth of roots and rhizomes of *Cenchrus setigerus* and *Lasiurus sindicus* as influenced by different cutting intervals (10, 20, 30 and 60 days), cutting heights (5, 10 and 15 cm) and nitrogen doses (0, 20, and 40 kg N/ha) imposed over three successive growing periods, was studied. Frequent cutting decreased the number and dry weight of root and the dry weight of rhizome in both the grasses. The height of forage removal did not influence the underground biomass of *C. setigerus*. In *L. sindicus*, forage removal close to the ground, decreased the number and dry weight of roots. Longer cutting interval, with application of a low maintenance dose of nitrogen, improved the underground biomass production in these grasses.

INTRODUCTION

Grasses occupy a key position in the Indian desert vegetation because of their adaptability to adverse climatic and edaphic conditions. In addition to providing forage to livestock, the fibrous root system of grasses provides an effective control on soil erosion. However, due to the large population of livestock the grasslands are over-used, and experience defoliation stress. This causes range deterioration. Under such a situation, the changes produced in root and rhizome growth are rarely considered despite their vital link with the sustained yield of forage. An effective root system occupying sufficient soil volume imparts efficiency in the utilization of both soil moisture and nutrients, while the rhizomes as food-storage sites, have a significant influence on the regrowth. These considerations and the acknowledged role of nitrogen in growth processes, prompted us to investigate the effects of different levels of defoliation and nitrogen doses on the underground biomass (i.e. the growth of root and rhizome) of ***Cenchrus setigerus*** Vahl and ***Lasiurus sindicus*** L.

MATERIAL AND METHODS

Cenchrus setigerus and ***Lasiurus sindicus*** were established in the rainy season of 1975 on the sandy loam soil of the Central Research Farm of the Central Arid zone Research Institute, Jodhpur Plants were spaced 75 cm apart in 5.25 X 4.50 m plots, in a split plot design, with two replications. The treatments consisted of three nitrogen levels (0, 20 and 40 kg/ha as ammonium sulphate), four cutting intervals (10, 20,

30 and 60 days) and three cutting heights (5, 10 and 15 cm from ground). The effects of these treatments, imposed during July to October each year, for three years (from 1976 to 1978) were assessed in terms of dry weight and number of roots, and also the dry weight of rhizomes in the summer of 1979. The root system of only one randomly selected plant, from one replication, was excavated adopting the root box method described earlier (Shankarnarayan *et al.* 1979). The size of the root box was 30 cm cube.

RESULTS AND DISCUSSION

In both the grass species, the root number generally declined when the top removal was frequent (Fig. 1). For instance, the average reducation in the root number with respect to the control (i.e. 60 days interval of defoliation) under 10 and 30 days of cutting intervals was 59.2 and 47.9 percent, respectively, in ***C. setigerus,*** and 30.2 and 19 9 percent respectively, in ***L. sindicus*** Under the long cutting interval of 60 days, increasing levels of nitrogen progressively increased the root number in both the grasses. In ***C. setigerus,*** only 40 kg N/ha caused increased root number, that too only under 30 days cutting interval while in ***L. sindicus,*** application of 20 kg N/ha produced largest number of roots under 30, 20 and 10 days intervals of cutting.

The dry weight of roots also increased with the increasing intervals of cutting in both the grasses (Fig. 2). Application of 20 kg N/ha generally promoted the root weight, more so, under long cutting interval of 60 days but in ***L. sindicus,*** 40 kg N/ha resulted only in a marginally higher root weight.

The longer interval of cutting promoted the rhizome dry weight (Fig. 3). Application of nitrogen enhanced the rhizome weight, particularly when cutting intervals were long. On average, application of 20 and 40 kg N/ha promoted the rhizome weight by 35 and 49 percent, respectively, in ***L. sindicus*** and 30 and 80 percent, respectively, in ***C. setigerus.***

Kathju *et al.* (1979) reported that a longer interval of defoliation increased, and a frequent defoliation reduced the forage yield. Fertiliser nitrogen was also reported to have a favourable effect on forage yield. The present study indicates that these phenomena are intimately linked with the observed promotion of root and rhizome growth under long cutting interval and application of fertilizer nitrogen.

Weaver and Darland (1947) observed a higher root growth in undefoliated grasses. The root growth in range species declined under frequent clippings (Dwyer *et al.*, 1963) and in forage crops like ***Danthonia caespitosa, Atriplex*** sp.and ***Medicago sativa,*** severe defoliation lead to increased mortality of roots (Hodgkinson and Becking, 1977). In several other studies the effects of defoliation or grazing on root growth were not obvious (Lorenz and Rogler, 1967; Bartos and Sims, 1974; Buwai and Trlica, 1977).

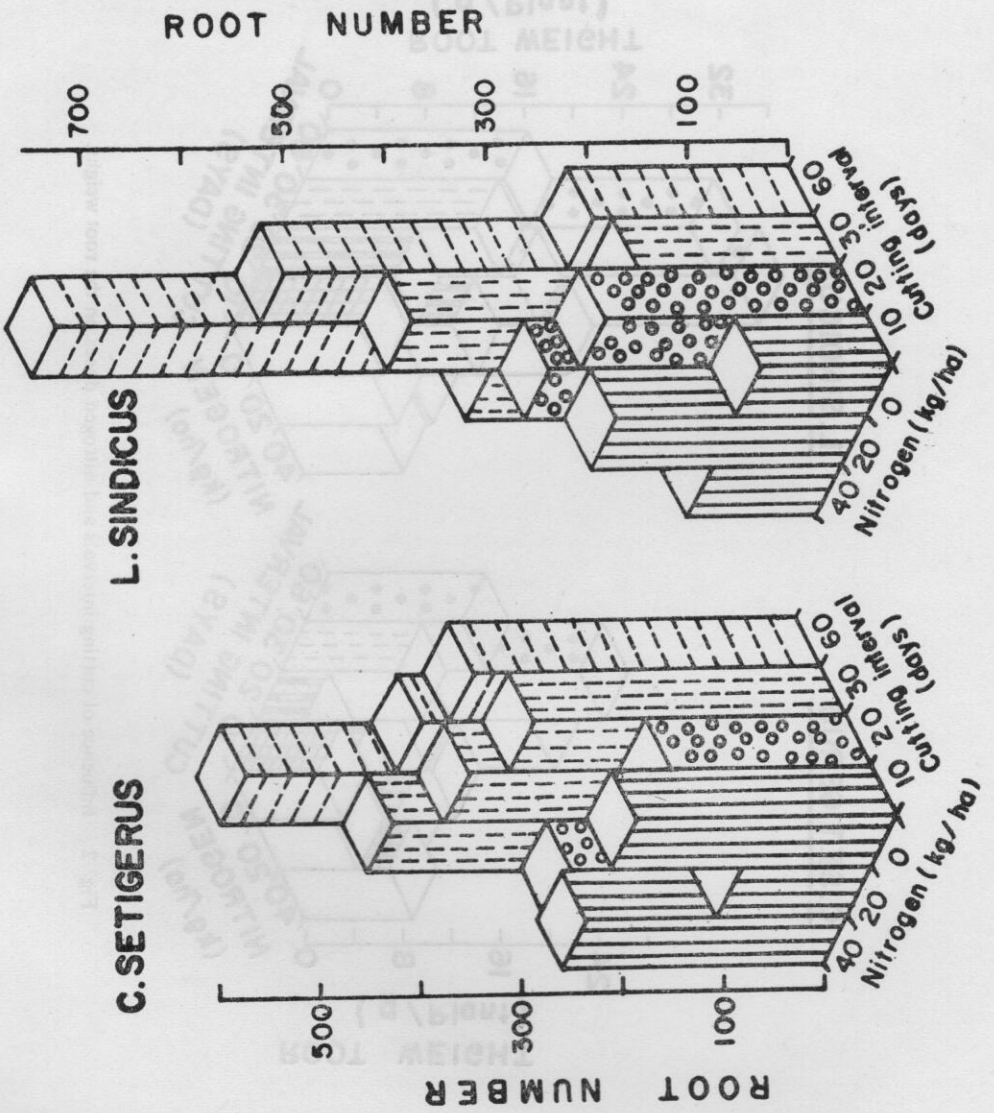

Fig. 1 Influence of cutting intervals and nitrogen doses on the root number of *C. setigerus* and *L. sindicus*

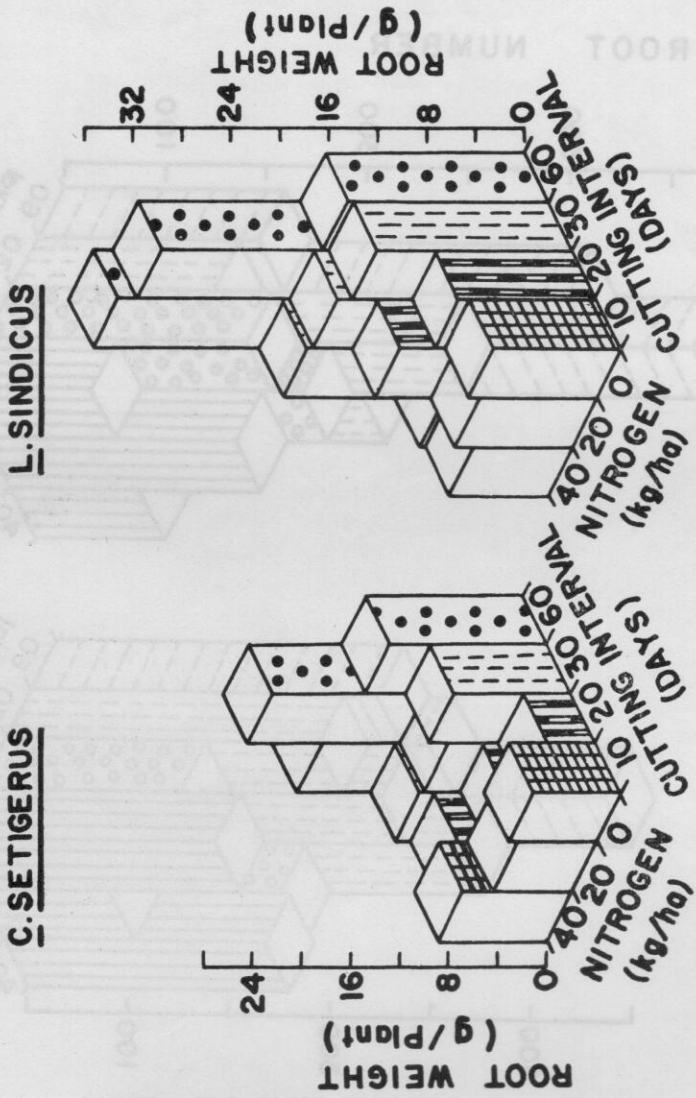

Fig. 2 Influence of cutting intervals and nitrogen doses on the root weight.

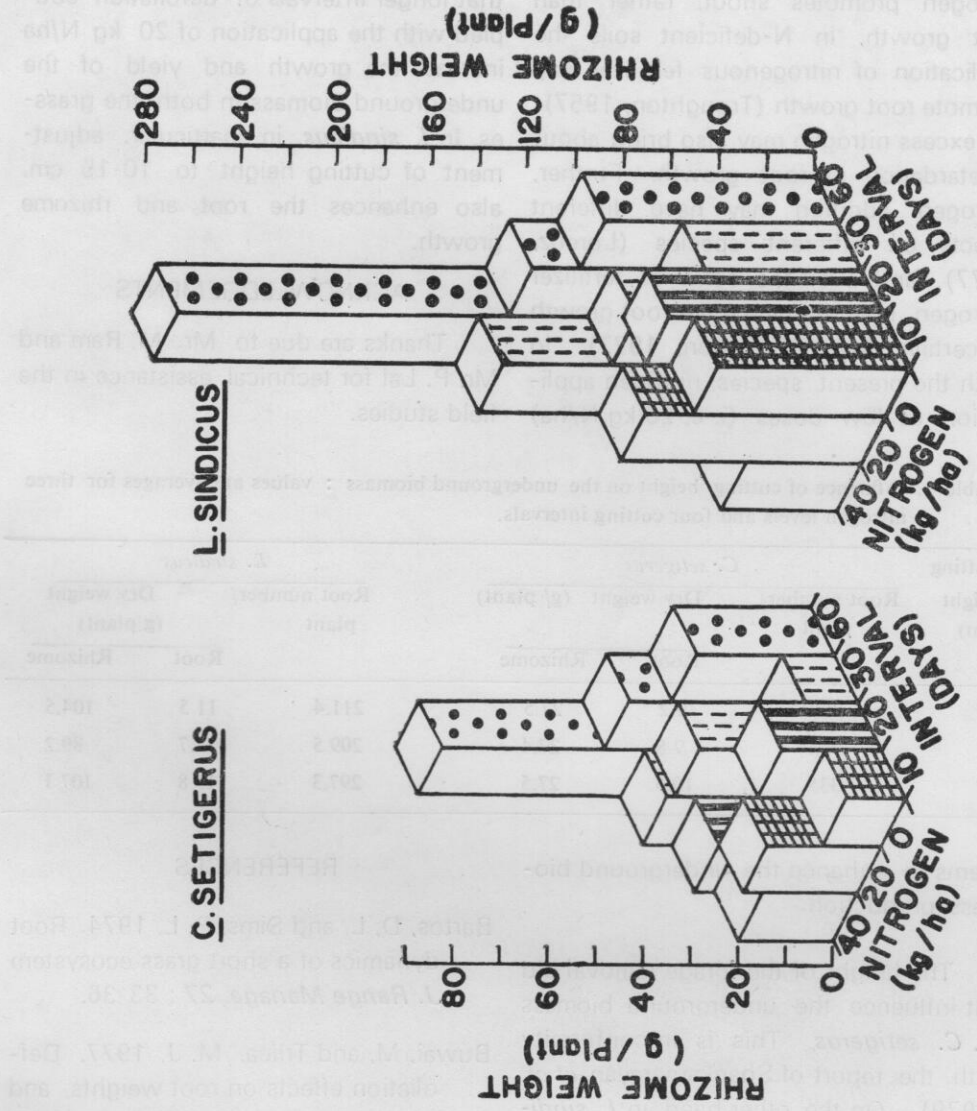

Fig. 3 Influence of cutting intervals and nitrogen doses on the rhizome weight.

Although it is generally felt that nitrogen promotes shoot, rather than root growth, in N-deficient soils the application of nitrogenous fertilizer may promote root growth (Troughton, 1957). An excess nitrogen may also bring about a retardation in root growth. Further, nitrogen addition may have different effects on different species (Lorenz, 1977), and even the form of fertilizer nitrogen may influence the root growth in certain cases (Sahlstron, 1977). In both the present species, nitrogen application at low doses (i. e. 20 kg N/ha) seems to enhance the underground biomass production.

The height of the forage removal did not influence the underground biomass of ***C. setigerus***. This is in conformity with the report of Shankarnarayan *et al.* (1979). On the other hand, in ***L. sindicus***, removal of top very close to the ground decreased the root growth in terms of number and dry matter (Table 1). Thus, in ***L. sindicus***, retaining the foliage up to 15 cm above the ground substantially improved the root growth.

The present study has demonstrated that longer intervals of defoliation coupled with the application of 20 kg N/ha increase the growth and yield of the underground biomass in both the grasses. In ***L sindicus***, in particular, adjustment of cutting height to 10-15 cm, also enhances the root and rhizome growth.

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Table 1. Influence of cutting height on the underground biomass : values are averages for three nitrogen levels and four cutting intervals.

Cutting height (cm)	*C. setigerus*			*L. sindicus*		
	Root number/ plant	Dry weight (g/ plant)		Root number/ plant	Dry weight (g/plant)	
		Root	Rhizome		Root	Rhizome
5	390	10.2	27.5	211.4	11 5	104.5
10	394	9 8	27.4	209 5	12.7	89.2
15	335	10.5	27.5	297.3	15.8	107 1

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