Competition between Two Desert Varieties of *Medicago laciniata* (L.) Mill. under Controlled Conditions

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Summary. Two varieties of *Medicago laciniata* common in the Negev desert of Israel reveal a distinct pattern of distribution within two different plant communities: *M. laciniata* var. *laciniata* occupies northern slopes and wadi beds within the association of *Artemisia herba-alba*, and *M. laciniata* var. *brachyacantha* occupies more arid southern slopes within the Zygophylletum dumosi association. Recent field trials have shown that interaction within the plant community restricts distribution of the two varieties, particularly on the northern slopes.

Using the de Wit model on competition, an attempt was made to determine whether the distribution found in nature can be explained on the basis of competition for space. Intervariety competition was measured under controlled conditions in a phytotron under two water regimes. It was found that under both "wet" and "dry" conditions, the two varieties utilize the same space \((RYT - 1)\) and similar quantities of water, and both produce similar amounts of dry matter. According to the total dry matter, the varieties have about the same competitive ability under wet as well as under dry conditions.

However, under the dry treatment the relative crowding coefficient, based on seed yield, is very different from one: \(k_{lb} > 2\). The relative reproductive rate \(\alpha_{lb} < 1\), found under both water regimes, indicates that var. *brachyacantha* will replace var. *laciniata* through competition for the same space. This is not in accordance with the observations that var. *brachyacantha* is absent in the less arid northern slope. A possible explanation is discussed.

Reciprocal thinning of the one variety from various mixtures grown under the "dry" regime, when followed by irrigation to field capacity, sharply increases the consumption of water by the plants left, proportional to the number of plants removed. This does not occur in cultures grown under the "wet" regime. It is suggested that such competition for water under optimal water conditions may be due to the occurrence of associations of roots. The possible formation of root associations and its ecological significance of their effect on water consumption are discussed.

Introduction

*Medicago laciniata* (L.) Mill. is a winter annual represented in the Negev desert of Israel by two varieties: *M. laciniata* var. *laciniata* and *M. laciniata* var. *brachyacantha* Boiss. (further on: *Mll* and *Mlb*, respectively), the latter with smaller pods and shorter spines (Fig. 1). Near Sede Boqer (30°52'49"N, 34°51'27"E) populations of the two varieties occupy two adjacent but distinct territories which have different soils and different plant communities. *Mll* occurs on the less arid northern slopes and in wadi beds within an association of *Artemisia herba-alba*, whereas *Mlb* grows on arid southern slopes and hill tops within a Zygophylletum dumosi association. Both meet along the base of the southern slopes where intermediate
forms occur within a narrow strip (Fig. 2). In a recent publication, Friedman and Orshan (1974) have described field trials in which each variety was sown on the opposite slope, both within the surrounding stand as well as on a cleared plant-free area, and suggested that the pattern of distribution is determined at least partly by interaction with the surrounding plants. Such interaction is triggered by favourable rainy winters, which also result in high seed yields. Seeds of each variety possess considerable longevity and therefore one rainy winter suffices to determine the pattern of distribution over a long period. Relatively strong plant interactions were observed on the northern slope, where other annual species are very sparse and perennial aromatic shrubs of Artemisia herba-alba are common. It has been suggested that this interaction is either due to competition for space or a result of an allelopathic effect which specifically affects those plants which invade from one slope to the other. In the present study we tried to determine whether competition between the varieties is for the same space (space in the sense of physical space as well as of exhaustible growth factors) may explain the extermination of a variety. In order to test the effects of competition for the same space, the varieties were grown in a phytotron, in monocultures of two densities as well as in mixtures of different proportions, and under two different water regimes with controlled light, temperature and humidity.