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Grassland improvement by reseeding native legumes and protection from grazing in the Bekaa Valley, Lebanon

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SUMMARY - We worked in collaboration with one farming community at Bekaa, Lebanon, to test some techniques for the improvement of degraded Mediterranean pasture. The techniques depend on over sowing with native legumes, fertilization and exclusion of grazing during April-May every year. The results indicated significant improvement on pasture productivity and potential economic benefits to the users. The adoption of the technology will require government help with seed production and means to regulate grazing.

Key words: Pastures, legumes, reseeding, grazing, Lebanon.

RESUME *- "Amélioration des pâturages par sursemis des légumineuses autochtones et mise en défens du bétail dans la vallée de Beka'a, Liban". Nous avons travaillé en collaboration avec une communauté agricole à Beka'a, Liban, afin de tester des techniques d'amélioration des pâturages méditerranéens dégradés. Ces techniques reposent sur un surensemencement avec des légumineuses autochtones, la fertilisation et l'exclusion de pâturage pendant les mois d'avril et mai chaque année. Les résultats ont montré une amélioration significative de la productivité des pâturages ainsi que des avantages économiques potentiels pour les utilisateurs. L'adoption de la technologie exigera l'aide du gouvernement en ce qui concerne la production de semence et les moyens de gérer le pâturage.*

Mots-clés *: Pâturage, légumineuse, surencemencement, pacage, Liban.*

Introduction

Mediterranean grasslands occur within the cereal zone of west Asia, where cropping is not possible because of shallow, stony soils and steep slopes. These native pastures are sometimes referred to as marginal lands because there is no alternative use to grazing. They are overgrazed by sheep and goats and frequently suffer from nutrient deficiency (N and P) and severe soil erosion. They are either managed by local communities or held as government-owned land. In Lebanon these represent around 35% of the total area of the Bekaa valley, classified as plain, foothills and hills facing the valley. Grasslands are heavily grazed, particularly in spring (Cocks and Thomson, 1988), and due to low productivity, large amounts of supplementary feeds such as barley grain, cereal and legume straw, green barley, crop by-products, and sown forages are fed to small ruminants. Improved productivity of grasslands should reduce supplementation needs and increase carrying capacity. In their study at Terbol, Lebanon, during 1984-88 Osman and Cocks (1992), indicated that natural grasslands were dominated by annual grasses (*Aegilops, Hordeum, Bromus, Lolium* and *Poa*), and that the legume density was low, which resulted in low legume productivity, especially in winter.

Sowing of exotic legumes - four cultivars of subterranean clover (*Trifolium subterraneum* L. cvs Mt. Barker, Woogenellup, Clare and Seaton Park) resulted in slight but not significant improvement in pasture productivity even when phosphate fertilizer was added. An important finding however, was that partial protection from grazing (for one or two months in late winter and spring) more than doubled the legume seeds in the seed bank. It was also noted that native legumes (mostly small seed clovers) are

abundant on the pasture. These clovers are particularly adapted to the intensive overgrazing because their small seed size enable them to pass through the digestive system of small ruminants (Thomson *et al.*, 1990).

In subsequent effort, the above species and many other native legumes were collected and their seed multiplied with the purpose of using them for rehabilitation of degraded Mediterranean pastures. The buildup of seeds in the soil is an essential step towards improvement of productivity in degraded pastures in Lebanon, which form a large part of the land surface, and on which small ruminant production largely depends. The objective of this study is to test the technique of pasture improvement under farming community conditions in the Bekaa area of Lebanon.

Materials and methods

The study was started in 1992 on a government-owned hill behind Terbol, near Zahle, in the Bekaa Valley of Lebanon (33° 49'N, 36° 09'E). The area is generally steep with hills rising 1100-1200 m above sea level. The soil is shallow (7 to 26 cm) with a pH between 6.9 and 7.9 and a relatively high level of phosphorus (10-20 mg kg^{-1}). The ground is covered with rocks.

The long-term average rainfall of the site is about 600 mm $year^{-1}$. The area is heavily grazed in early winter, spring and early summer by sheep and goats from nearby villages. There were four treatments: (1) seeding with a mixture of native legumes, (2) seeding and fertilizing with phosphate fertilizer at 60 kg P_2O_5 ha^{-1}, (3) natural pasture (control) and (4) natural pasture (open access to grazing). Each treatment occupied a plot of 100 m x 15 m, running down the north-facing slope except treatment 4, where the plot was 0.25 ha. There were four replications. The phosphate was broadcast at the time of sowing the seed mixture during early November. The experimental area - except treatment 4 - was excluded from grazing during April - May every year (a guard was hired for the purpose). Grazing was allowed for the protected area for ten days in March 1996 by 700 sheep.

The following species are included in the pasture seeding: *Trifolium stellatun* L., *T. campestre* schreb., *T. tomentosum* L., *T. resupinatum* L., *T. purpureum* Loisel., *T. lappaceum* L., *T. speciosum* Willd., *T. angustifolium* L., *T. haussknechtii* Boiss., *T. scabrum* L., *T. pilulare* Boiss.; two selections of *Medicago rigidula* L. 1919 and 716) and one selection of *M. rotata* Boiss.; *Scorpiurus muricatus* L. and *Hippocrepis unsiliquosa* L. All the species except medics were mixed and broadcast at a total seed rate of 9.6 kg ha^{-1} while the medics were sown at a rate of 100 kg pods/ha (25 kg/ha each accession).

Results and discussion

Pasture productivity was improved significantly as the result of sowing new legumes compared to the control treatment. The addition of phosphate fertilizer improved the dry matter productivity even further, though the difference was not significant over the natural protected or sown pasture (Table 1). The legume component of the pasture increased as a result of sowing and fertilization treatment by 1.5 to more than 3-fold over the natural protected and natural open access pastures, respectively. Total herbage production was similar for the treated or protected plots, however they all produced more dry matter than the open access pasture (Table 1). Pasture seed bank was lowest under continuous (open access) grazing. Excluding grazing during the critical time of the season - without any other treatment - resulted in increases of legume seed number and seed weight of more than 2-fold over the open access grazing (Table 1). This confirms previous results by Osman and Cocks (1992), who indicated that partial protection from grazing for one or two months in late winter-spring more than doubled the number of legume seeds in the seed bank compared with open grazing. The pasture in the present study was re-opened for grazing for ten days in March 1996 by 700 sheep (owned by eight people). This was estimated to have resulted in saving in the supplementary feeds by 1400 USD.

The results in the present study confirm previous findings obtained on the station at ICARDA, and suggest that these techniques of pasture improvement can be extended to grazing lands used by the farming communities. However, it is important to find ways of regulating grazing on these pastures to allow seed setting by the newly sown species. It is also important to secure the seed production for these legumes, probably through government institution, if it is to be adopted on a large scale.

Table 1. Herbage yield of legume and total herbage yield (legume + grass + other species) in April 1994 and legume seed mass (g m^{-2}) and seed number (m^{-2}) in June 1995 in different types of pastures at Terbol, Lebanon

	Herbage t ha^{-1}	
	Legume	Total
Natural pasture (open access)	0.26 c	1.06b
Natural pasture (protected)	0.48 cb	2.44a
Sown pasture	1.08 ab	2.12a
Sown and fertilized pasture	1.2 a	2.66a
SEM (4 observations per mean)	0.19	0.32

	Legume seed[1]			
	Mass	SEM	Number	SEM
Natural pasture (open access)	3.66	0.83 (10)	3065	575 (10)
Natural pasture (protected)	11.63	1.85 (10)	9696	1448 (10)
Sown and fertilized pasture	14.47	1.61 (20)	8235	965 (20)

[1]Based on samples taken along unreplicated transects along different types of pastures. Number of observations per mean in parenthesis

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