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Systèmes sylvopastoraux. Pour un environnement, une agriculture et une économie durables

Zaragoza : CIHEAM
Cahiers Options Méditerranéennes; n. 12

1995
pages 109-112

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Résumé : On a étudié la localisation, la croissance et la valeur nutritive des populations autochtones d'Atriplex halimus en Aragón. Onze populations ont été comparées avec A. halimus amélioré en Tunisie et A. nummularia sous des conditions de zones semi-arides, non salines. Dans sa majorité, A. halimus a été localisé dans la rive gauche de la rivière Ebre, dans les régions de Bardenas et Monegros. Les arbustes autochtones ont présenté un développement moindre, des feuilles plus petites et un port moins dressé que la population Tunisienne. La composition chimique de la fraction broutée n'a pas montré une différence entre les populations et les espèces. On n'a pas apprécié une sélectivité de la part des animaux.

Mots-clés : Arbustes fourragers, flore, croissance, composition chimique.

INTRODUCTION

Planting saltbushes is an effective way of restoring depleted Mediterranean rangelands. In this area, one of the most appreciated species is *Atriplex halimus L.* but it includes many populations of different grazing value (Correal, 1991; Le Houerou, 1992).

In Aragón (North-East of Spain), *A. halimus* grows spontaneously in semi-arid areas of saline depressions of the Ebro basin (Gonzalez and Allue, 1972). The aim of this study was to collect the *A. halimus* populations and assess their agronomic and grazing value.

MATERIAL AND METHODS

The experiment was carried out on 11 populations collected by mapping different sites in Zaragoza (Aragón), during the 1990-1993 period. One population of *A. halimus* bred in Tunisia and one population of *A. nummularia* bred in South Africa were included as controls.

The study was conducted on fifteen saltbushes per population distributed in 3 blocks at random. Saltbushes were planted in a plot of 2000 m2 under dryland field conditions and alkaline and non saline soils. Four similar plots were established for grazing studies.

The climatological conditions during the period of recordings were 9°C and 20.9°C as the mean minimum and maximum temperatures respectively, -6°C the minimum winter temperature and 304,8 mm the mean annual rainfall.

The characters studied were volume of saltbushes estimated as a theoretical cylinder with mean diameter and height of each individual plant; growth habit as the diameter:height rate; leaves measures; bloom date; analytical constituents of the browsed part (ashes, crude protein, neutral detergent fibre, acid detergent fibre, acid detergent lignin, in vitro digestibility of the dry matter) every two months and palatability.

RESULTS

Distribution of A. halimus in Aragón

Saltbushes were mainly located on the left bank of the Ebro river, in the new irrigated lands, on soils characterized by a moderate presence of salts. They were also found in scattered points of ravines and salt marshes of both banks of the river. *A. halimus* proved to be a halophyte species being specially located on the borders of fields, paths and in any place where the soils had been turned over.

Establishment of the experiments

In the months following the establishment of experiments, 3.7% autochthonous *A. halimus* plantlets, 1.3% *A. halimus plantlets from Tunisia and 17.3% A. nummularia* plantlets died. Frosts of -6ºC produced the death of some young shoots of *A. nummularia.*

Growth evolution

Volume

At the end of the study period, the final volumes reached by saltbushes were 3.7 m3 in *A. halimus* from Tunisia, 2.6 m*3 in autochthonous A. halimus* and 1.6 m3 in *A. nummularia.* There were found highly significant differences ($P<0.01$) between species. The range of variation between autochthonous populations was between 3.1 and 1.6 m^3/saltbush, with significant differences ($P<0.05$).

Growth habit and height

Autochthonous populations showed a less upright growth habit. The relationship between the diameter and height of saltbushes at the end of the study were 1.40, 1.36 and 1.22 for the autochthonous *A. halimus*, A. halimus from Tunisia and *A. nummularia* respectively, being the mean heights 112 cm, 129 cm and 106 cm ($P<0.01$). The range of variation in growth habit between the different autochthonous populations of *A. halimus* was from 1.53 to 1.26 ($P<0.05$), observing that some populations and saltbushes showed a tendency to a creeping growth habit.

Size of the leaf

The length and width of leaves were constant all along the year, being the mean measures 2.8 and 1.7 cm, 3.6 and 2.1 cm and 3.3 and 2.0 cm for autochthonous *A. halimus*, A. halimus from Tunisia and *A. nummularia* respectively. Differences were highly significant between species ($P<0.01$), standing out the larger size of *A. halimus* leaves bred in Tunisia in relation to the autochthonous populations. There were not significant differences between the last ones ($P>0.05$).

Flowering period

Flowering started in June in the case of A. halimus with flower buds formation and finished in October with seed ripening. Full flowering took place all along the months of August and September. There were some differences of up to 15 days between populations, being those from Tunisia the latest ones. Flowering of A. nummularia started in January and finished in June with the ripening of the seed, full flowering took place in May.

Chemical analysis and feeding value of the browsing fraction

The chemical composition and the feeding value of the browsing fraction did not show significant differences ($P>0.05$) between the different populations and species. The mean values reached by the different components were: dry matter (27.3+6.20%; ashes 20.7+3.27%; calcium 1.7+0.44%, potassium 2.8+0.57%; sodium 4.3+1.16%; chlorine 5.6+2.01%; CP 20.0+3.72%; NDF 39.8+5.67%; ADF 21.2+7.46%; ADL 9.8+3.00% and IVDMD 71.0+10.16%.

Differences were, however, highly significant ($P<0.001$) when comparing the recordings made in the different seasons of the year. May recordings reached the minimum values in dry matter, NDF, ADF and ADL and the maximum ones in CP, minerals and IVMD; and in November the opposite. Between both dates, there was a gradient in the obtained values.

Browsing

There was not any estimation of selectivity of any of the origins in the flock in the two years study. The flock profited the saltbushes gradually according to the proximity to a water point.

DISCUSSION

The habitat of the A. halimus populations in Aragón agrees essentially with that described by Le Houérou (1992) who situated this species in the saline depressions with deep soils where the water availability is higher and the concentration of salts makes difficult the development of other species. The proliferation of saltbushes observed in the new irrigated lands of the left bank of the Ebro river could be due to the soil turning off made in order to change the cultivated lands into areas with a moderate salt contents, thus making easier their spreading in the sides of the fields and paths of that region where the presence of water and salts coming from irrigation, leaching and running off favoured their establishment.

The study made on the development of the autochthonous populations showed their similarity with A. halimus from Tunisia concerning the growing rate. The autochthonous populations presented, however, a smaller volume of the saltbush and a smaller size of the leaf. The reason could be their spontaneous origin without any breeding while those from Tunisia had been previously bred (Le Houerou, 1980). The morphological characteristics appreciated in the autochthonous populations, determined their including within the subspecies halimus, according to the description made by Le Houerou (1992) for the subspecies halimus and schweinfurthii.

Within the autochthonous populations no variability was appreciated either in the leaf size or in their reproductive cycle. However, there were variations in their volume and habit, what would make feasible the development of future breeding programmes on those subjects. The availability of saltbushes with creeping habit facilitates their exploitation by no browsing or small size animals.

A. nummularia showed a worse adaptation and a lower development than the different populations of A. halimus. Mortality was higher in the transplanting process and some young regrowths were frost when temperatures reached -5°C. This was already reported in previous studies on this species (Delgado 1992).

The chemical analysis made on all the populations, showed a high contents in ashes with a mean value of 20.7% as a consequence of the reported high contents of sodium and chlorine, with mean values of 4.3% and 5.6% respectively. Those minerals are inseparable from the species, as they play an important part as osmoregulators (Osmond et al., 1980). The obtained high contents in CP (20.0%), in theory adequate to cover the protean needs of animals (Fonnesback, 1984) cannot be considered as an indicator of the forage quality. The reason is

that according to the bibliographic checking made by Le Houerou (1992), 65% of the nitrogen is digestible but only 55% of that percentage is assimilated. Those populations from Aragón had a tendency to present a higher mean contents in NDF, ADF and ADL, reaching those components 42.9%, 25.1% and 10.7% versus 39.9%, 21.8% and 9.6% in A. halimus from Tunisia and 36.7%, 20.1% and 9.2% in A. nummularia. IVDMD was also lower with 67.0% in relation to 72.0% and 74.0% in the populations from Tunisia and A. nummularia respectively.

No selectivity of saltbushes by the animals was observed, in the successive recordings made during the two year study, what does not agree with the reports by other authors (Ibrahim, 1981; Aouissat, 1992).

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