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Acacia nilotica and *Medicago sativa*, Suitable Plants for Agro-Forestry in Southern Coasts of Iran

[1]Mohammad Hassan Emtehani and [2]Masoud Tabari
[1]Department of Rehabilitation of Desert and Arid Regions,
Faculty of Natural Resources, University of Yazd, Iran
[2]Department of Forestry, Faculty of Natural Resources and Marine Sciences,
Tarbiat Modares University, Noor, Iran

Abstract: Habitats of the multipurpose tree, *Acacia nilotica*, were identified along the coastline of the Persian Gulf and Oman Sea, south of Iran. Four sites were randomly chosen and in each one, vegetation as well as climatic and soil characteristics were studied. Likewise, biometry of *Acacia* trees was conducted and compared in the sites. The fodder values in leaf and fruit of *Acacia* were determined and compared with those of in foliage of *Medicago sativa* being managed under an agro-forestry system. By analyzing data it was revealed that the biggest trees were found in Dashteyari region and the smallest in Bamani region (both in the Oman Sea coast). Values in most of nutritional elements were higher in foliage of *Medicago* than in leaf and fruit of *Acacia*, respectively. From this investigation it is concluded that in south of Iran where the site is favorable for *Acacia* plantation, cultivation of *Medicago* or other adaptable crops together with *Acacia* can be developed as agro-forestry systems (such as undercropping and intercropping) if water is available.

Key words: *Acacia nilotica*, agro-forestry, fodder value, growth, *Medicago sativa*, nutrient elements

INTRODUCTION

One of the main tenets of agro-forestry is that trees maintain soil fertility (Palm, 1995). Accumulation of organic matter and conservation of nutrients under trees in agro-forestry systems are well documented (Nair, 1993; Young, 1997; Pandey *et al*., 2000). The nutrients generated by trees can be ex-ploited within production system, either simultaneously, as in intercropping, or sequentially, as in rotational fallow systems (Rhoades, 1997). However, nutrients generated by trees generally do not support growth of intercrops in simultaneous system (Puri and Bangarwa, 1992; Pandey *et al*., 1999).

Acacia nilotica is a multipurpose tree (Pandey and Sharma, 2003). It is a leguminous species spreading, depending on site with other *Acacia genus* as *A. ehrenbergiana*, *A. albida* and genus of *Prosopis*, in southern coasts and islands of Iran (Persian Gulf and Oman Sea). It is a severely light demanding tree with circular large crown (Sabeti, 1984). The tree individuals in particular in and around villages are maintained by residents (Djavanshir, 1998). Its natural habitats often occur in floodway and the local where the periodical or seasonal floods are gathered (Emtehani, 1998). Its foliage is directly or indirectly used by livestock and the wood is favorable for building-ship industries and particularly for boat (Shah-Beygi, 1992). The tree is socially accepted because it provides fuel, fodder, gum and local medicine to farmers. Nitrogen fixing ability of the tree makes it one of the most preferred species for agricultural fields (Puri *et al*., 1994). Tree builds up nutrients under its canopy and forms islands of nutrients in the fields (Pandey *et al*., 2000). However, the understorey crops are unable to utilize these nutrients due to limited light (Pandey *et al*., 1999). To those reasons, in these regions some plantations of *Acacia nilotica* together with other crops are observed as various agro-forestry systems. One of the main common crops growing as undercropping with *Acacia* is *Medicago sativa*. Generally there is not any report showing the suitable suite for *Acacia nilotica* plantation and its incorporation with *Medicago sativa* in southern coasts of Iran and islands Persian Gulf and Oman Sea.

To this reason, in this research stations of *Acacia nilotica* together with *Medicago sativa* are studied in southern coasts of Iran. The inventory for

Corresponding Author: Masoud Tabari, Department of Forestry, Faculty of Natural Resources and Marine Sciences, Tarbiat Modares University, Noor, Iran Tel: +981232220852 Fax: +981226253499

growth of *Acacia* is the main objective of this study. This, in fact, can assign the best *Acacia* sites in the investigated regions and propose the most suitable sites for its plantation development in future. The other principal goal is to determine the fodder values for livestock by comparing nutritional values of *Acacia* and *Medicago*. It is hypothesized that the sites benefiting the Oman Sea climate may produce bigger *Acacias*. Likewise, foliage of *Medicago* has higher nutritional elements than that of *Acacia*.

MATERIALS AND METHODS

In order to carry out the research after identifying the *Acacia nilotica* habitats in 2003, four main stations with situations illustrated in Fig. 1 and the characteristics given in Table 1 were randomly chosen along the coastline of Persian Gulf and Oman Sea, south of Iran. The data collected from the nearest meteorological station, showing a warm xeric climate with precipitation of 125-200 mm/year and a mean minimum absolute temperature of 3-8°C (Table 1). The main tree and shrub species accompanying with *Acacia nilotica* were specified in each station (Table 2).

The soil chemical-physical properties were assigned by digging a profile in each site (Table 3). The soils were identified with moderate texture, non-acidic pH and limestone bed. Biometry of all trees and shrubs, including diameter at breast height (d.b.h.), height and crown diameter, was made by 100% sampling. Nutrient of leaf and fruit of *Acacia* in Bamani region was compared with foliage of *Medicago sativa* growing as undercropping with *Acacias*. Data was examined by one-way analysis of variance (ANOVA) and tested for significance at 95% confidence limits with Tukey-HSD and t-tests.

Table 1: Geographical situation and climatic census of the study sites in southern coasts of Iran

Characteristics	Chahemoslem	Gaspirkartan	Bamani	Dashteyari
Altitude (m)	15	30	20	30
Longitude	54° 33'	57° 13'	57° 40'	61° 73'
Latitude	26° 42'	26° 16'	26° 49'	25° 80'
Mean annual rainfall (mm)	200	200	200	125
Mean min. absolute temperature (°C)	7	6	3	8
Climate type	Warm xeric	Warm xeric	Warm xeric	Warm xeric

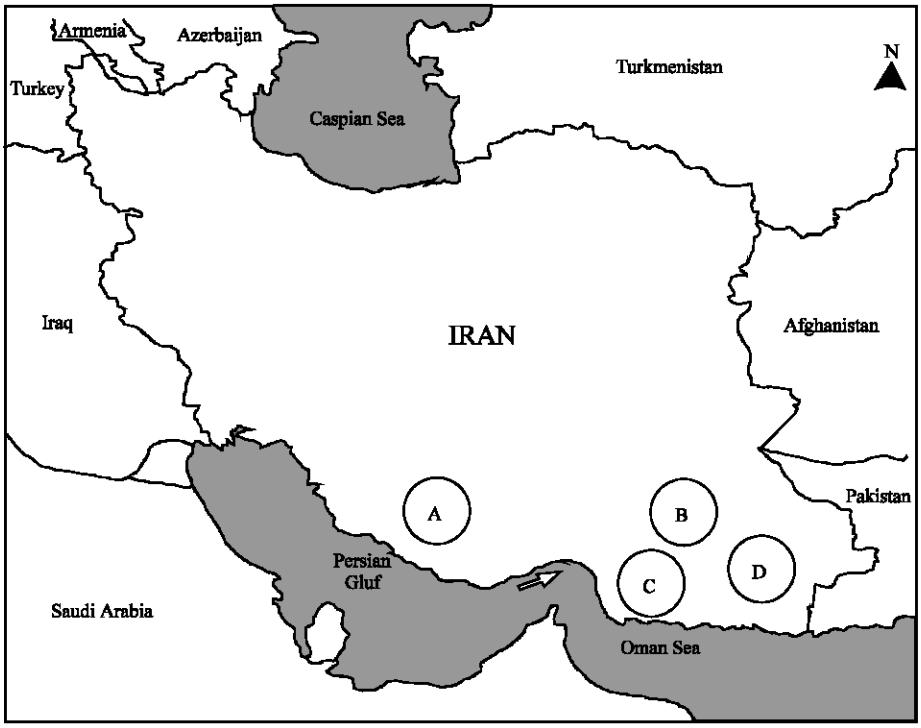

Fig. 1: Location of the investigation sites (showed in circular) in Persian Gulf and Oman Sea coasts, south of Iran (A = Chahemoslem, B = Gaspirkartan, C = Bamani and D = Dashteyari)

Table 2: Main tree and shrub species accompanying with *Acacia nilotica* in southern coasts of Iran

Species	Family
Acacia ehrenbergiana Hayne	Miomosaceae
Acacia tortilis (forssk) Hayne	Miomosaceae
Alhagi camelorum Fisch	Papilionaceae
Calotropis procera (Wild.) R. Br.	Ascleopiadaceae
Capparis decidua (Forssk.) Edgew	Capparidaceae
Leptadenia pyrotechnica (forssk) Dence	Ascleopiadaceae
Lycium sp. L.	Solanaceae
Pennisetum flaccidum Griseb.	Gramineae
Prosopis cineraria (L.) Druce	Miomosaceae
Prosopis farcta Banks and Soland	Miomosaceae
Prosopis koelziana Burkart	Miomosaceae
Salvadora oleoides Burkart	Salvadoraceae
Salvadora persica L.	Salvadoraceae
Tamarix sp. L.	Tamaricaceae
Ziziphus spina-christi (L.) Willd.var	Rhamnaceae

Table 3: Soil properties of *Acacia nilotica* sites in southern coasts of Iran

	Depth (cm)	Texture	EC×10^3	pH	TNV (%)	Organic matter (%)	P	K	Ca	Mg	Na	SAR
Chahemoslem												
	0-30	Silty-Loam	3.3	6.9	56.6	0.61	3.9	290	24.4	5.6	16	4.1
	30-100	Silty-Loam	3.2	7.3	56.6	0.14	1.4	110	32.0	2.0	12.5	3.0
Gaspirkartan												
	0-30	Loam	0.4	7.8	16.2	0.29	1.2	115	*	*	*	*
	30-100	Silty-Loam	0.3	8.1	15.2	0.24	5.5	110	3.0	2.6	1.3	0.2
Bamani												
	0-30	Clay-Loam	0.6	8.1	16.2	0.01	3.6	210	2.2	0.6	2.5	2.1
	30-100	Loam	0.7	8.5	24.9	0.06	0.7	115	1.8	5.2	1.3	0.7
Dashteyari												
	0-30	Silty-Loam	5.2	7.6	18.2	0.77	*	*	18.2	9.4	32	8.6
	30-100	Silty-Loam	10.6	7.8	22.1	0.17	*	*	17.7	18.2	89.5	20.4

-Unit for nutrient elements is ppm, *Data is not accessible

RESULTS

In the four investigated sites the means of diameter at breast height (d.b.h.), height and crown diameter of *Acacia* trees were 27.2 cm, 8.3 m and 8.7 m, respectively (Table 4). The biggest d.b.h. (35.5 cm) allocated to Dashteyari and the smallest one (17.7 m) to Bamany. The greatest height (11 m) was recorded in Dashteyari and the shortest height was noted in Bamani. Crown diameter was biggest (11.3 m) in Gaspirkarten and shortest (6.5 m) in Bamani. Generally the biggest trees were found in Dashteyari and then in Gaspirkartan and the smallest in Bamani.

The amount of protein, lignin and ash, N, P, K and Mg was higher in foliage of *Medicago* than leaf and fruit of *Acacia* (Table 5). By contrast, amount of fat, NFE, TDN, Ca, Fe and Br was lower in foliage of *Medicago* than leaf and fruit of *Acacia*. However, most of the nutritional values for *Acacia* were greater in leaf than fruit. As a whole, no significant differences could be detected in Mg of leaf and fruit of *Acacia* and in Mn, Zn of leaf of *Acacia* and foliage of *Medicago*.

Table 4: Biometry of *Acacia nilotica* trees in the experimental sites of southern coasts of Iran

Location	D.b.h. (m)	Height (m)	Crown diameter (m)
Chahemoslem	23.6b	7.0b	7.7bc
Gaspirkartan	31.9a	9.6ab	11.3a
Bamani	17.7c	5.5c	6.5c
Dashteyari	35.5a	11.0a	9.2b
Mean	27.2	8.3	8.7

-Means, followed by different letter(s) in column differ significantly ($p<0.05$) among sites, using Tukey's test

Table 5: The comparison of nutrient values in leaf and fruit of *Acacia* and foliage of *Medicago* in Bamani (Oman Sea coast)

	Acacia nilotica		*Medicaco sativa*
Variable	Leaf	Fruit	Foliage
Protein (%)	12.8b	10.1c	15.5a
Lignin (%)	13.1b	24.7a	28.0a
Fat (%)	2.2a	1.1c	1.7b
Ash (%)	3.1b	2.3c	9.0a
NFE (%)©	68.9a	38.3b	*
TDN (%)	65.7a	35.5c	53.0b
N (%)	2.0b	1.6c	2.4a
P (%)	0.15c	0.17b	0.22a
K (%)	0.69c	1.05b	1.53a
Ca (%)	1.77a	0.84c	1.25b
Mg (%)	0.31b	0.17b	3.70a
Na (%)	0.14b	0.99a	0.11b
Fe (ppm)	245.7a	114.9c	150.0b
Mn (ppm)	31.5a	14.6b	31.0a
Zn (ppm)	27.4b	38.2a	25.0b
Cu (ppm)	13.0a	7.0b	14.0a
Br (ppm)©	57.4a	4.0b	*

-Different letter(s) in row are significantly different ($p<0.05$), using Tukey's test, *Data is not accessible, ©Different letter(s) in row are significantly different ($p<0.05$), using t-test

DISCUSSION

The results reveal that the *Acacias* growing in Dashteyari and Gaspirkartan benefit from a greater d.b.h. and height compared to other two sites. The *Acacias* of Bamani have the smallest d.b.h. and height among the investigated sites. Gaspirkartan produces the largest and Bamani the smallest crown diameter for this species. However the biggest trees are observed in Dashteyari and the smallest in Bamani, situated in Oman sea coast.

The values in nutrient elements are mostly higher in foliage of *Medicago* than leaf and fruit of *Acacia*. In *Acacia* it is often greater in leaf than fruit. Similarly, protein and TDN in leaf of *Acacia* is bigger than its fruit, showing a higher nutrient value for the leaf in comparison with the fruit. Likewise, compared to foliage of *Medicago*, the lower rate of ash and lignin in leaf is a positive value for Acacia. Generally, it can be confirmed that integration of *Acacia* and *Medicago* in the warm xeric plains of south of Iran increases biomass and nutrient of crops and the villagers' income, as well (Emtehani, 2003).

This is while that the best places in order to plantation development and agro-forestry practices may be mainly suggested for Dashteyari and then for Gaspirkartan in the Oman Sea coasts. It can be also declared that *Acacia* growth will be enhanced when cultivated as an agroforestry system along with *Medicago*, particularly in well-irrigated and manured fields (Djazirei, 1987, 2001). In reality, such a method will promote more closely nutrient cycling than only agricultural system (Sreemannarayana, 2003) applied with *Medicago*. This technique not only improves the rehabilitation of deforested areas but also solves the unemployment problems and progresses the cultural-economical-social conditions in the region (Agha-Zamani, 1987).

Regarding the above-mentioned, we found the biggest *Acacias* in Oman Sea coasts and high nutrient in leaf of *Medicago* in the investigated sites, however it is proposed that the sites suitable for *Acacia nilotica*, in south of Iran (particularly the southern coasts of country and islands of Persian Gulf and Oman Sea), where the environment is suitable from viewpoint of water and soil, cultivation of *Acacia* along with *Medicago* or other adaptable crops should be developed by different agro-forestry systems, including undercropping and intercropping. Of course such as old traditional practice, canopy management of the tree can not be followed by farmers but the trees can be cut and sell ≥ 12-year-old after completion of the rotation cycle. In reality, crop yields will increase when trees are cut or coppiced in agro-forestry system (Tilander *et al*., 1995; Szott *et al*., 1999).

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