MARRAKECH
جامعة القاضي عياض
UNIVERSITÉ CADI AYYAD

كليـــــــة العلوم السملالية - مراكش
FACULTÉ DES SCIENCES SEMLALIA - MARRAKECH

Master Biodiversité, Changement Climatique &Développement Durble
Semestre 1 - 2019-2020

Module :
'SYSTEMATIQUE, EVOLUTION ET BIOGEOGRAPHIE [SEB]'
Elément 1 :
SYSTEMATIQUE ET EVOLUTION

PRACTICAL WORK

Genetic diversity of date palm (*Phoenix dactylifera* L.). Isoenzyme-based investigations on the diversity of Marrakech date palm grove and the effect of climate change.

Realized by :
- Sana ELGHALI
- Khadija TALBI
- Fayçal AIT BOUMALLASSA
- Lahoucine ECH-CHATIR

Framed by :
Professor M. BAAZIZ

SUMMARY

SUMMARY 1
INTRODUCTION 1
OBJECTIFS 1
Markers used in genetic diversity studies. 2
Analysis of the genetic diversity of the date palm by Biosys-1 program. 2
Relationship between Marrakech date palm grove and other Moroccan palm groves based on isozyme markers. 3
Discussion 4
Verification of the hypothesis dealing with seedling origin of Marrakech date palm grove 4
Discussion 5
Marrakech palm grove facing climate change. 5
CONCLUSION 6
REFERENCES 7
ANNEX 8

INTRODUCTION

Date palm tree (*Phoenix dactylifera* L.) is considered as one of the oldest and main staple and ancient crops in South-west Asia and North Africa. Besides, dates can be grown in Australia, Mexico, South America, southern Africa, and the United States, especially in southern California, Arizona, and Texas (Chao and Krueger, 2007). Flowers of date palm tree are small and yellow colored attached directly to spikelets which develop as fruits called date palm fruits (El Modafar and El Boustani, 2001; Biglari *et al.*, 2007).

Unlike most palms, the Date Palm is dioecious, meaning each plant is either male or female. Only female plants produce fruit, provided there is a male plant nearby. In order for its fruits to mature, it requires high temperatures and generous amounts of water (CSBE., The Center for the Study of the Built Environment)

In Morocco, the palm is grown in several areas south of the Atlas Mountains along the wadis, nearly 4.8 million palm trees on an area of 48,000 ha, the majority of this heritage is mainly concentrated in the valleys of Drâa, Ziz, Tafilalet and the Bani (Tata) zone, which alone represent about 90% of the total (MAPM., 2009). Prospecting the date palm groves has shown that khalts (plants derived from seedlings) represented more than 50% of the Moroccan date palm groves. More than 220 cultivars have been reported, but only 38 of them were studied based on their morphological characteristics and resistance to Bayoud disease (Saaidi, 1979)

The Marrakech date palm grove (of low fruit production), was characterized by high levels (79.2%) of unknown material, which corresponded to khalts (also called sairs and deguels) derived from germinated seeds. Except for populations in M'hamid and Rissani, khalts represented about 67% (\$11%) of each date palm grove. (Saaidi, 1979)

The origin of the palm grove of Marrakech is still unknown, chroniclers, travelers and historians, talk about the presence of a palm grove during the 11th and 12th century. some Assumptions say that it was born during the time of the Almoravids. (OPM., Observatory of the Marrakech Palm Grove, 2012)

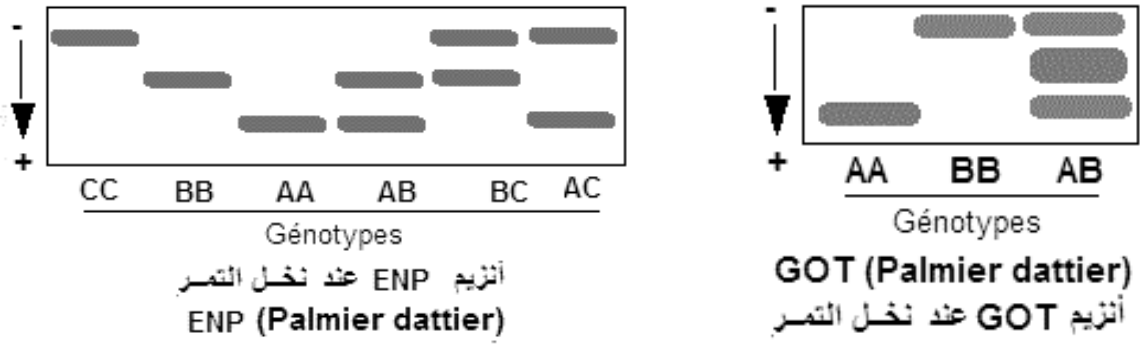
OBJECTIFS

This practical work involves an activity which consists of: the study of genetic diversity of date palm (*Phoenix dactylifera* L.), Isoenzyme-based investigations on the diversity of Marrakech date palm grove using Boissys-1 program, and the study of climate change's effect on date production in Marrakech.

Markers used in genetic diversity studies.

Markers usually used in genetic diversity studies are hydrolases and transaminases because of their properties and advantage since they are considered as simple and codominant markers. The enzyme systems used in this study corresponded to endopeptidases (ENP), glutamate oxaloacetate transaminase (GOT) and esterases (EST).

Fig1. Representation of the zymograms of endopeptidases (ENP) and glutamate oxaloacetate transaminase (GOT) extracted from date palm leaflets.



Based on these enzymatic systems, studies carried out on date palm cultivars renowned in morocco have been able to restore a table with the characteristics of all cultivars (Annex).

Analysis of the genetic diversity of the date palm by Biosys-1 program.

BIOSYS-1 is a FORTRAN IV program designed to aid biochemical population geneticists and systematists in the analysis of electrophoretically detectable allelic variation. It can be used to compute allele frequencies and genetic variability measures, to test for deviation of genotype frequencies from Hardy-Weinberg expectations, to calculate F-statistics, to perform heterogeneity chi-square analysis, to calculate a variety of similarity and distance coefficients, and to construct dendrograms using cluster analysis and Wagner procedures. The program, documentation, and test data are available from the authors.

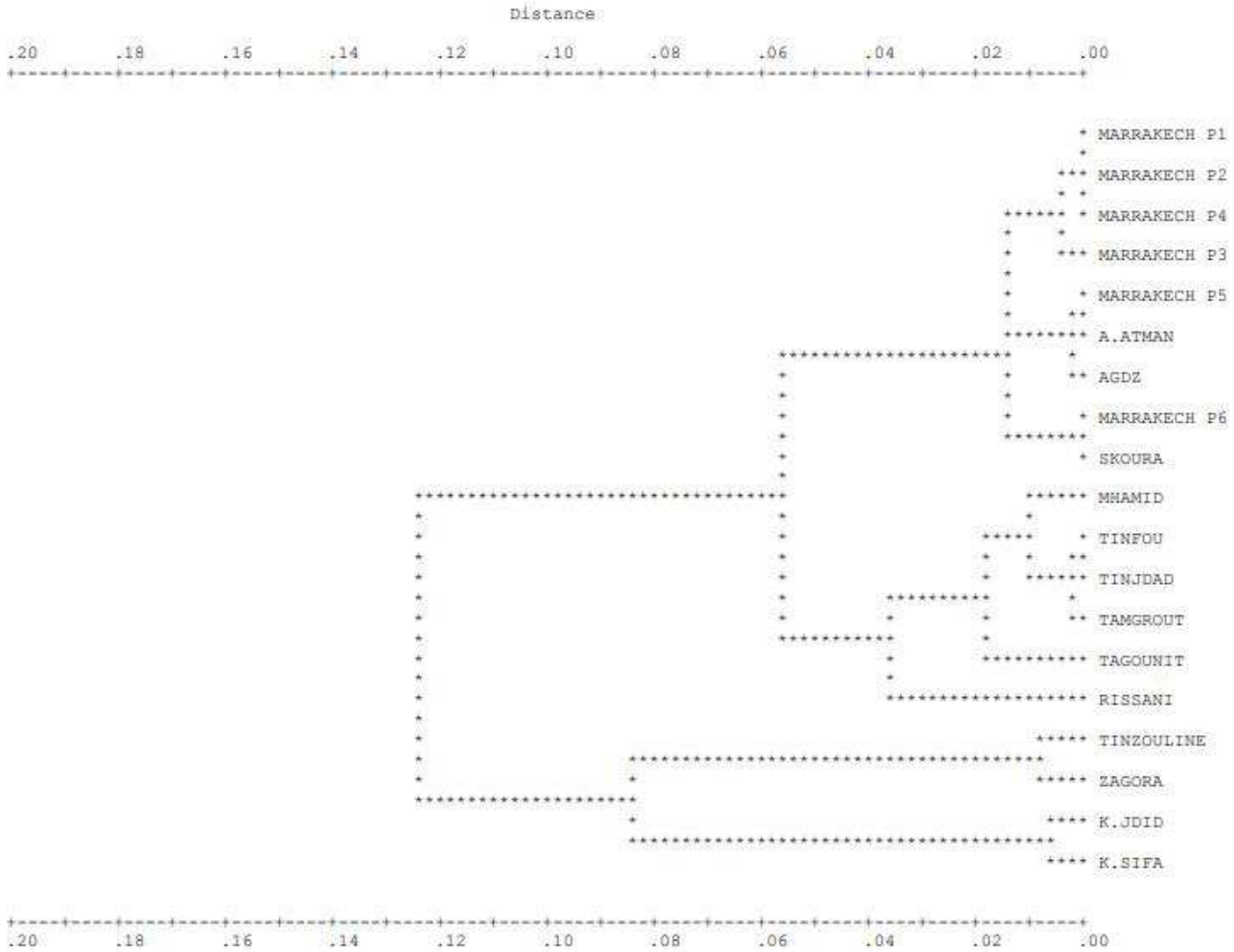
BIOSYS 1 is a single multipurpose program that performs most types of data analysis commonly employed by biochemical population geneticists and systematist and thus alleviates most of the above problems.

- In a singl run of the program, all following analyses must be performed;
- Computation of allele (electromorph)frequencies
- Measures of genetic variability
- Hardy-Weinberg equilibrium

- F statistics (Wright's1718 F statistics for the analysis of population structure by standardized genetic)
- Heterogeneity chi-square
- Similarity and distance coefficients
- Cluster analysis
- Distance Wagner procedure
- since 1989, 698 scientific papers are published results treated by using this program.

Relationship between Marrakech date palm grove and other Moroccan palm groves based on isozyme markers.

Fig 2 : cluster 1 covering all palm groves



Discussion

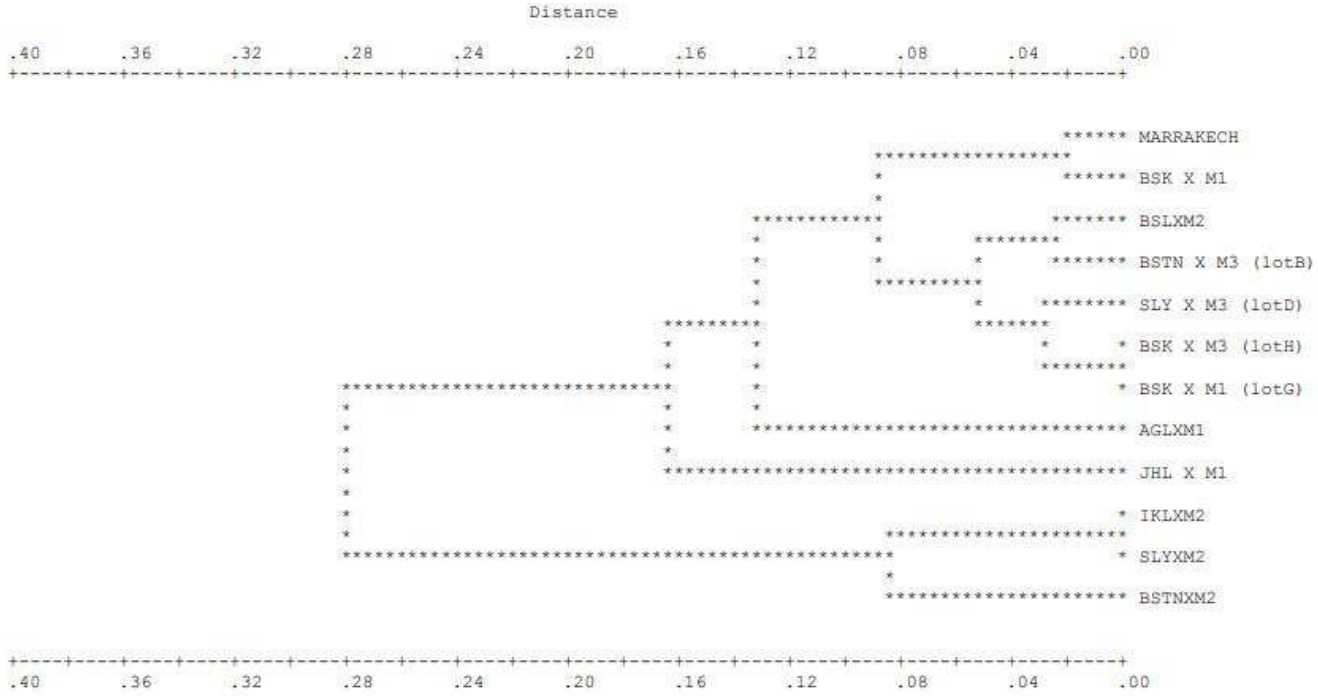
After the introduction of data from different palm groves in the Biosys-1 program, the factorial component analysis show that the Marrakech date palm grove situated at the northern side of High Atlas, is related to date palm groves of AIT ATMAN, AGDZ and SKOURA,

On the basis of these results we can say that the palm grove which has developed over time randomly, because a part of 54% of all trees exhibited male sex (Majourhat et *al.*,1999), from the kernels of dates thrown at the foot of springs and wadis, places of stages or encampments of caravans or travelers, who are from AIT ATMAN, AGDZ and SKOURA.

Assumptions have been made that it was born at the time of the Almoravids, but it is admitted as probable, that in 1126/1127 Sultan Ali Ben Youssef called builders from the oases of southern Morocco for the construction of city's ramparts and whose food was mainly composed of dates, and that these builders threw the dates stones at the foot of springs, resurgences or wadis, places of their stages or encampments during the trip to Marrakech, and the palm groves developed from these dates kernels. (Observatory of the Marrakech Palm Grove, 2012).

Verification of the hypothesis dealing with seedling origin of Marrakech date palm grove.

Fig 3 : cluster 2 covering seedling from different cultivars



Discussion

If considering the palms of Marrakech being a single variety and comparing the results obtained on the second cluster, also the genetic distance between the varieties, we can deduce that the closest variety of that of the palms of Marrakech is Bouskri

This confirms the interpretations of the first discussion because this variety of the date palm produces dry dates that can be transported and can withstand the changing travel conditions of workers from south to north.

Marrakech palm grove facing climate change.

For date production, thermal accumulation must be at least 3000°C, which may take several months, Boufaggous variety (BFG) in Morocco only needs 1300-1800 degrees and it's called an early cultivar. Thermal accumulation is calculated as follows:

(daily average temperature - 18) x number of days from flowering to maturity

(often calculated from May until the beginning of October).

Accumulative Heat = (Ta - 18) x D? = 3000 (for six months), D? = Days

Table1 : An example of Thermal accumulation's application

Months	Mai	June	July	Aug	Sept	Oct
Number of Days	31	30	31	31	30	7
Ta	29,5	34	38,5	39	39,5	39,5
Accumulative Heat Day	11,5	16	20,5	21	21,5	21,5
Thermal accumulation	2918,5					
Ta + 1°C	30,5	35	39,5	40	40,5	40,5
Accumulative Heat Day	12,5	17	21,5	22	22,5	22,5
Thermal accumulation	3078,5					

The results show that by adding 1°C to the daily average temperature, the Thermal accumulation becomes superior to 3000 which is good for date production.

Climate change is supposed to cause increasing of daily temperatures under the effect of greenhouse gases during the following years, which will improve the productivity of some plants in Marrakech palm grove.

The yield is supposed to be too limited, because:

- This palm grove faces several constraints such as salinity, drought due to heavy pumping of groundwater from tourism projects and golf complexes, and other biotic and abiotic factors that cause serious damage to the palm grove of Marrakech. (Meddich et *al.*, 2004)
- A part of 54% of all trees exhibited male sex. (Majourhat et *al.*,1999)
- The high rate of evaporation, and the lack of rainfall.

CONCLUSION

Most palm clones are randomly selected by farmers and propagated vegetatively, resulting in novel varieties, and since the first fructification is only obtained For about 5-8 years, early varietal identification remains difficult apart from the use of other morphological or 'isoenzyme' markers and DNA fragments separated by electrophoresis. These markers play a very important role in the identification of the different varieties, which makes it possible to direct the in vitro multiplication towards good quality cultivars and also the improvement of fruit quality. It could also determine the origin of date palms of the Marrakech's palm grove and many other palm groves. Markers are also considered as the second eye on the evolution of the population of (*Phoenix dactylifera* L.) all over the world.

REFERENCES

- **Biglari, f., al karkhi, a. f., and easa, m. (2007).** antioxiddant activity and phenolic content of varios date palm (*phoenix dactylifera*) fruits from iran. food chem. 107, 1636–1641. doi: 10.1016/j.foodchem.2007.10.033.
- **BIOSYS-1: a FORTRAN program for the comprehensive analysis of electrophoretic data in population genetics and systematics.** David L. Swofford, Richard B. Selander ,Journal of Heredity, Volume 72, Issue 4, July 1981, Pages 281–283,
- **Chao, c. c. t., and krueger, r. r. (2007).** the date palm (*phoenix dactylifera* L.): overview of biology, uses, and cultivation. hortscience 42, 1077–1082.
- **El modafar, c., and el boustani, e. (2001).** cell wall-bound phenolic acid and lignin contentes in date palm as related to its resistance to fusarium oxysporum. biol. plantarum. 44, 125–130. doi: 10.1023/a:1017942927058.
- **K. Bendiab et *al*./Biochemical Systematics and Ecology 26 (1998)** 71—82
- **MAJOURHAT, K., BENDIAB, K. & BAAZIZ, M. 1999**. Etude comparative des palmiers dattiers mâles et femelles de la région de Marrakech réalisée sur la base des phénotypes isoenzymatiques des estérases, peroxydases et endopeptidases. Al Awamia 100, 41-49.
- **Meddich A., Oihabi A., Bizid E. et El Hadrami I., (2004)** : Rôle des champignons mycorhiziens VA dans la tolérance du palmier dattier (Phoenix dactylifera L.) au déficit hydrique. Revue des Régions Arides. Ns. 2, pp. 640-645.
- **Ministère de l'Agriculture et de la Pêche Maritime, 2014**. L'Année Agricole Juillet 2014. Note stratégique n°98.
- **Observatoire de la Palmeraie de Marrakech (OPM.), (2012)** : Présentation de la palmeraie, l'Association pour la Sauvegarde et le Développement de la Palmeraie de Marrakech (ASDPM) (consulted 26.10.2019).
- **Saaidi, M., 1979**. Contribution à la lutte contre le Bayoud, fusariose vasculaire du palmier dattier. Thèse de Doctorat d'Université de Dijon.
- **The Center for the Study of the Built Environment (CSBE.),** consulted (25/10/2019), http://www.csbe.org/date-palm-phoenix-dactylifera

ANNEX

Key to populations

Original pop. no.	Pop. no. on printout	Population name
MARR	1	MARRAKECH P1
MARR	2	MARRAKECH P2
MARR	3	MARRAKECH P3
MARR	4	MARRAKECH P4
MARR	5	MARRAKECH P5
MARR	6	MARRAKECH P6
SKOU	7	SKOURA
AGDZ	8	AGDZ
TINZ	9	TINZOULINE
ZAG	10	ZAGORA
MHAM	11	MHAMID
TINF	12	TINFOU
TAMG	13	TAMGROUT
TAGO	14	TAGOUNIT
TINJ	15	TINJDAD
RISS	16	RISSANI
AATM	17	A.ATMAN
KJDI	18	K.JDID
KSIF	19	K.SIFA

Date palm cultivars used in this study and their principal characteristics

Cultivar*	Abbreviation	Fruit characters	Origin
Bou-Skri	BSK	Dry date, high quality, in season	Draa, Bani
Bou-Feggous ou Moussa	BFGM	Soft date, low quality, in season	Bani
Bou-Sthammi Blanche	BSTB	Soft date, medium quality, in season	Bani
Bou-Zeggar	BZG	Half-soft date, good quality, in season	Gheris, Draa
Haoua	HOA	Half-dry date, medium quality, in season	Tafilalet
Race-Lahmar	RLM	Half-dry date, mediu quality, in season	Tafilalet
Bou-Sthammi Noire	BSTN	Soft date, medium quality, late	Draa, Saghro
Mest-Ali	MST	Half-dry date, very good quality, in season	Draa
Jihel	JHL	Half-dry date, good quality, in season	Draa, Bani Saghro
Oum-N'hale	OMH	Soft date, very good quality, in season	Draa
Ahardane	AHD	Half-soft date, good quality, in season	Tafilalet
Bou-Cerdoun	BCD	Half-dry date, medium quality, in season	Tafilalet
Bou-Ittob	BIT	Half-dry date, medium quality, in season	Bani
Outoukdim	OTK	Half-dry date, good quality, in season	Todra
Mah-Lbaid	MLB	Soft date, good quality, very late	Draa
Tadment	TDMT	Half-dry date, good quality, precoce	Draa, Saghro
Admou	ADM	Half-dry date, good quality, in season	Tafilalet, Draa
Bel-Hazit	BAZ	Half-soft date, medium quality, in season	Tafilalet
Mekt	MKT	Soft date, medium quality, in season	Draa, Bani
Sair Layalet	SLY	Half-dry date, good quality, in season	Bani
Azegzao	AZO	Dry date, low quality, precoce	Tafialet
Iklane	IKL	Soft date, low quality, very late	Draa, Bani
Bou-Feggous	BFG	Soft date, very good quality, precoce	Everywhere
Bou-Temda	BTD	Half-dry date, medium quality, in season	Bari
Aguelid	AGL	Half-soft date, good quality, very precoce	Draa, Saghro
Bou-Slikhene	BSL	Half-dry date, medium quality, in season	Tafilalet
Aïssa-Youb	AIB	Half-dry date, medium quality, in season	Draa
Mejhoul	MJH	Soft date, very good quality, precoce	Tafilalet

*Cultivars were described in Saaidi (1992), except for the varieties AHD and MJH.

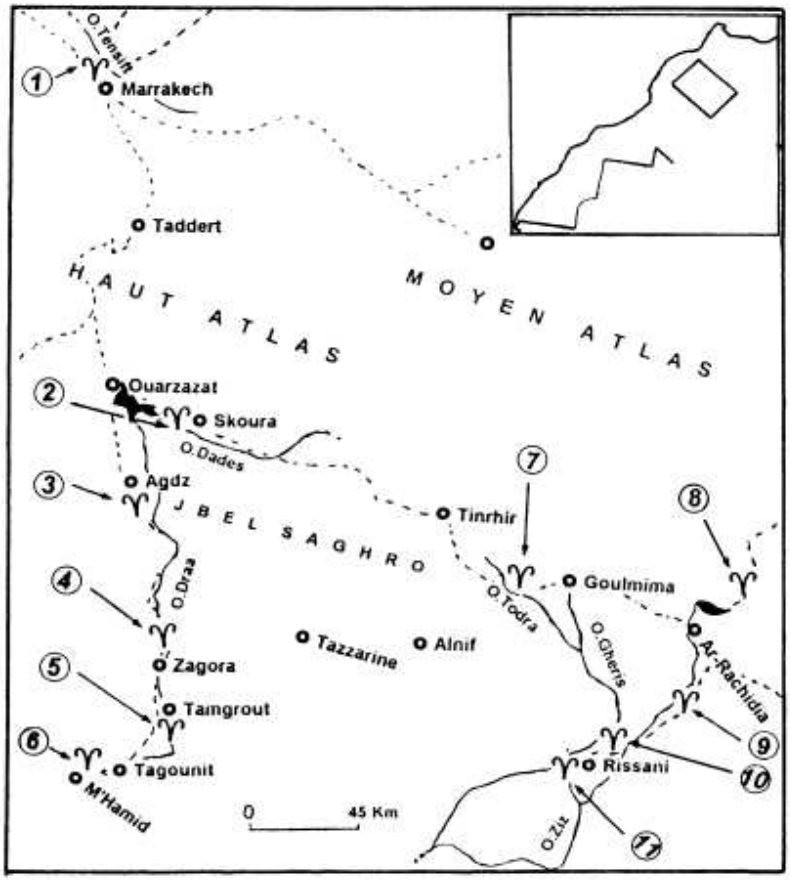


Fig. 1. Map of Moroccan region indicating sampling localities.

(Bendiab et *al.*,1998)