

Efficiency and resilience of forage resources and small ruminant production to cope with global challenges in Mediterranean areas

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Sorghum bicolor (L.) Moench, importance and utilization in the northwest of Morocco

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Abstract. Sorghum (*Sorghum bicolor* (L.) Moench) is an important cereal crop for animal and human nutrition. With climate change problems, due to its low water requirements, sorghum appears to be an important crop in Morocco, for areas with poor soil and in the absence of any irrigation. Our prospection consisted in collecting sorghum ecotypes from farmers in the northwest of Morocco. In parallel with the field trips, surveys were carried out on cultural techniques, different uses, production constraints and cultivation in the region. Area cultivated with sorghum varied from 150 m² to 1.5 ha, and 80% of farmers rotate with wheat or barley. Sorghum is harvested from September to November, and the yields are influenced by the weather conditions. They are low and range from 2 tons/ha to less than 200 kg / ha. The major problems of sorghum in the region are that of birds devastating grains, and that of cryptogamic diseases like *Sporisorium ehrenbergii* and nonagrioid *Sesamia* attacks. 80% of the farmers cultivate the sorghum for animal and human self-consumption. Sorghum is used in the feeding of cattle, sheep and poultry. The average price of sorghum is 5 dh/kg. It increases to 8 dh/kg during the sowing period.

Keywords. *Sorghum bicolor* – Cultivation – Utilization – Northwest of Morocco.

Sorghum bicolor, importance et utilisation au Nord du Maroc

Résumé. Le sorgho (*Sorghum bicolor* (L.) Moench) est une culture céréalière importante dans le domaine de la nutrition animale et humaine, au nord du Maroc. Avec la problématique du changement climatique, de par son cycle réduit et ses faibles besoins en eau, le sorgho semble être une culture importante à utiliser sur un sol pauvre en absence de toute irrigation. Notre prospection a consisté à collecter 24 écotypes de sorgho auprès des agriculteurs de la région de Tanger Tétouan El Hoceïma. Parallèlement aux visites de terrain, des enquêtes ont été menées sur les techniques culturales, les différents usages, les contraintes de production dans la région. La superficie cultivée en sorgho varie entre 150 m² et 1,5 ha et 80% des agriculteurs l'utilisent en rotation avec le blé ou l'orge. Le sorgho est récolté au début de la saison des pluies et les rendements sont influencés par les conditions climatiques. Ils sont faibles et vont de 2 tonnes / ha à moins de 200 kg / ha. Les principaux fléaux du sorgho dans la région sont celui des oiseaux dévastateurs des céréales et celui des maladies cryptogamiques telles que *Sporisorium ehrenbergii* et les attaques de *Sesamia nonagrioides*. 80% des agriculteurs cultivent le sorgho pour leur propre consommation, animale et humaine. Le sorgho est utilisé dans l'alimentation des bovins, des ovins et de la volaille. Le prix moyen du sorgho est de 5 dh / kg. Il peut atteindre 8 dh / kg pendant la période de semis.

Mots-clés. *Sorghum bicolor* – Cultivation – Utilisation – Nord-ouest du Maroc.

I – Introduction

Sorghum (*Sorghum bicolor* (L.) Moench) is the fifth most important grain crop in the world, after maize, wheat, rice and barley, in terms both of production and of area under cultivation (FAO, 2013). Africa and India are large producers and account for more than 70% of world production (FAO, 2013). However, in Morocco sorghum is not an important cereal crop. It is grown and maintained as an ancestral crop only in the northwest of the country where it is used as food and feed (Kadiri and Ater, 1997). Sorghum is considered as a moderately threatened crop, compared to wheat, rye, peas and chickpeas that are considered highly threatened (Ater and Hmimsa, 2008).

To preserve these local resources from genetic erosion, the collection of germplasm and *ex-situ* conservation is a necessity (Mekbib, 2012). In addition, to study the new options of ruminant feed supplementation by this crop, it is important to understand the diversity of this crop in its geographical area as well as the traditional systems of its conduct. The aim of this study was to characterize sorghum cultivation throughout the northwest region of Morocco.

II – Materials and methods

The study was conducted in Tangier-Tetouan-El Hoceima region from 3rd September to 10th October 2018. It consisted in collecting sorghum ecotypes from fields in order to characterize their agro-morphological and bromatological aspects. Data were collected from farmers using a participatory research evaluation method based on observations and interviews. This area was divided into two agro-ecological zones: i) the Rif mountains, which brings together a silvopastoral ecosystem and a subsistence agricultural activity, and ii) the Tangier-Larache region with more developed sorghum cultivation.

The collected information related to cultural techniques, plant morphological description, different uses, production constraints and the future of the culture in the region. The information was collected from both sexes and different age groups. The interviews with the elderly were of great help.

III – Results and discussion

1. Vernacular name

Local varieties in northwestern Morocco belong to a single race “*durra*” with only two distinct forms: cernuum (draa hamra) and durra (draa bayda), as (Kadiri and Ater, 1997) described them. Farmers distinguish among the two forms according to the color of the seeds. In the Jebha region, they call it “*Draa sghira*” referring to the size of the seeds that are small compared to the large size of corn seeds “*Draa kbira*”. In the province of Larache, they call it “*kssiba*” which means little cane. This diversity of vernacular names reflects the diversity of sorghum ecotypes in this region.

2. Cultural techniques

In the agrosystem of the Rif, sorghum is cultivated on poor, hilly and rocky soils called “*ferrich*” in the local jargon. It is grown in heavy clay soils called “*Tirs*” in the province of Tangier.

According to farmers, sorghum is an easy crop in terms of farming techniques. Only soil preparation requires time and effort. 80% of farmers do a single tillage in spring. Farmers whose plots exceed one hectare use mechanical soil tillage. Those with small plots use animal traction. On average 8 days are needed for the preparation of the soil and the sowing of 1000 m² using animal traction while it takes only 1 hour for the mechanical tillage of one hectare. The duration depends on the speed of the machine, soil texture and humidity.

100% of the surveyed farmers cultivate sorghum under rainfed conditions, the sowing of sorghum taking place between early March and the end of May. Seeding is done manually with an average amount of 15 kg seeds/ ha.

The cultivated area of sorghum varies between 150 m² and 1.5 ha. Occupied sorghum plots are small in the Rif agro-ecosystem compared with the provinces of Tangier and Larache. The cultivation of sorghum is threatened by the cultivation of cannabis.

80% of farmers rotate sorghum with wheat or barley. They claim that the roots and residues of these two crops contribute to the fertilization of the land. However, the best results are obtained after a legume harvested in green (Noutfia and Baya, 1997).

Sorghum is harvested at the end of summer. Harvesting begins around the end of August and lasts until the end of September for certain late varieties. Premature varieties prevail in arid areas while late varieties dominate in wetlands. In mountain areas, the harvest is done manually using a sickle. Some farmers tear the whole plants to cut the panicles later. They dry the rest of the plant and use it to cover other crops. In plains where cultivation occupies large areas, the harvest is mechanized. In this case, at harvest the panicles must be dry enough to prevent their loss by the machine. To avoid losses due to storage, the panicles are dried under the sun. The grains of sorghum are separated from the panicles by a hammering operation using a pestle after drying.

Yields are influenced by climatic conditions. They are low and range from 2 tonnes / ha to less than 200 kg / ha. Thus, local varieties under optimal conditions produce low yields compared to improved varieties. Yet, sorghum yield, production and surfaces are stable compared to other cereals (Chantreau and Cruz, 2013).

3. Crop diseases

Our prospection concerned the whole region of Tangier Tetouan El Hoceima. But in general, we noted differences between the agrosystem of the Rif and the Tangier-Larache area. The major threat of sorghum in the region is grain-eating birds. The intensity of the attack is high in the area of Taounate El Hoceima because the sorghum plots are rare and scattered.

Another threat is cryptogamic diseases. 7% of the observed fields in the region were affected by panicle elongated coal (*Sporisorium ehrenbergii*) (Fig. 1.a). It is called "kohhila" in the local jargon. 50% of the fields where the coal had been encountered were completely infested because the spores are easily disseminated in the air. Farmers do not take steps to avoid or alleviate losses. Only one farmer buried the infected crop residues, but it was too late because the seeds were perforated and always exposed to the wind which scatters the spores.

The region of Tangier, especially, experiences an attack of *Sesamia nonagrioides* (Fig. 1.b). 100% of farmers in this area reported this disease. They call it "douda" in the local jargon to refer to worms or lepidopteran larvae. This larva perforates the stem from the inside but does not affect the panicle. Farmers do not make any prevention or treatments because they do not see a loss in terms of yield, probably because the attacked plants produce new healthy stems that replace the infected ones. To reduce the spread of this disease, when the plant is at a height of 20 cm high, one of the farmers allows his sheep flock to graze for half a day, in order to cut the upper parts and eat the infected stems.

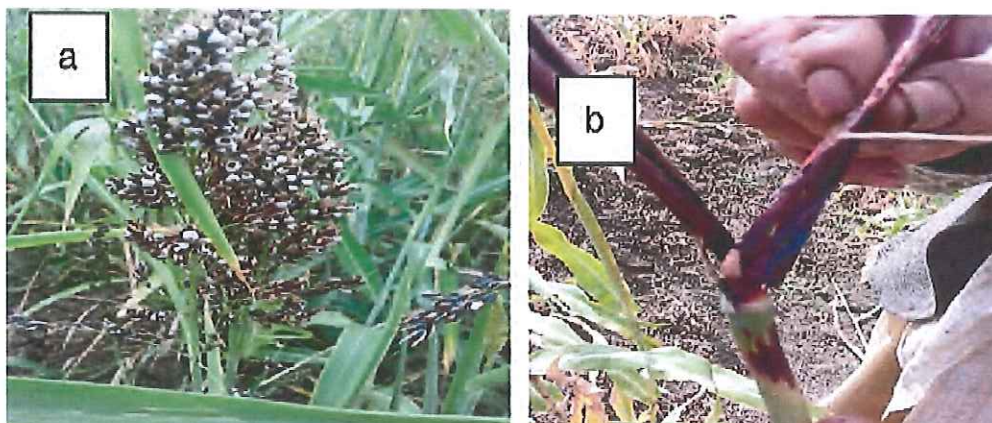


Fig. 1. Sorghum diseases in northwest of Morocco.

4. Sorghum utilization

Sorghum is a moderately threatened crop (Ater and Hmimsa, 2008). 80% of farmers grow it for animal and human consumption. In the Rif Mountains, sorghum is consumed only by the elderly as semolina or flour for bread making. Others grow it as a fence in gardening plots.

Sorghum is used in the feeding of cattle, sheep and poultry. Breeders accuse sorghum of poisoning livestock when they consume young plants or regrowths. They distinguish between red sorghum which is more toxic compared to white sorghum. This problem decreases with the growth of the plant and ends at the heading stage.

Sorghum grains are used during the summer season. For 30 farm chickens, farmers use as feed 1.5 kg of sorghum in the morning and 1.5 kg in the evening. Fowls are sold in local markets; a large cock can be sold 100 to 120 dh while a small one is sold 60 to 70 dh.

Breeders in the region have two cows and two calves on average. For lactating cows, they give an average of 0.5 kg of sorghum grain mixed with other seeds for an average of 2 kg of concentrate per animal per day. They mix it with barley, wheat and cereal bran.

The farming system is agro-pastoral. In the summer, farmers harvest crop residues. The stems and leaves remaining in the plots are grazed by animals. In this state, the cows consume it without any problem. The breeding system is breeder-fattener, so half of the amount of milk produced is given to the calves. On average, manual milking generally yields of about 4l / cow / day.

Sorghum grains are also used in the fattening of the calves and sheep for the *Aid* ceremony, especially during the finishing phase which requires a rich energy supply. They are mixed with faba beans in addition to mineral complements. With a starting weight of 150 kg and a final live weight of 350 kg, in a period of 3 months, the farmer can sell this calf at 15 000 dh.

The average price of sorghum is 5 dh / kg. This amount can increase to 8 dh / kg during the sowing period. Farmers state that sorghum is less profitable compared to other crops, but the ease of farming techniques encourages them to cultivate it.

IV – Conclusion

Sorghum is a traditional crop used for animal and human nutrition in traditional area of northwest morocco. It is cultivated within a rainfed system and its yields depend on climatic conditions. Surveys are important to understand its cultivation and utilization in the area, but measurements should be taken to improve the agro-morphological characterization of its agro-ecotypes and ultimately their utilization.

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