### Box 2.9 Namibian cucurbits: potential dryland crops

Southern Africa is an important centre of diversity for the family Cucurbitaceae (melons), of which 43 species in 14 genera occur in Namibia. Several endemics and near-endemics are found here, including the *Inara* melon *Acanthosicyos horridus*, which is endemic to the Namib.

Lucrative cultivated crops such as sweet melon *Cucumis melo* and watermelon *Citrus lanatus* originated in southern Africa. Other cucurbits are traditionally used in local agriculture and subsistence gathering. Many, especially *Citrus*, can produce large fruits in dry seasons, yielding nutritious pulp and seeds with a high oil and protein content. They therefore have excellent potential for development to supplement or replace cereal production in arid regions. Even so, the Cucurbitaceae are poorly known. The taxonomy of the group is still in doubt; basic data on many species are lacking, and the ancestral forms of cultivated species have been largely ignored in crop improvement programmes.

The National Botanical Research Institute is investigating and documenting the agricultural potential of indigenous cucurbits in a project co-founded by the MAWRD and the Danish Government. This aims to improve the yield and quality of selected species and promote agricultural use. Crop diversification will also permit the productive use of marginal lands by farmers with limited resources. Because the cucurbits already occupy a niche in traditional agroecosystems, cuisine, culture and economy in Namibia, they are in many ways preadapted for a new level of exploitation.

— Gillian Maggs

### Recommendations

- Prioritise species and habitats for study, including genetic diversity analysis.

- Include genetic diversity as a criterion for selecting new conservation areas.

  — Herta Kolberg

### Genetic diversity of indigenous food crops

Crop genetic diversity is often overlooked as it is difficult to measure at a large scale.\(^{122}\) However, judging from the rest of Africa, it is safe to assume that substantial crop genetic variation exists both within and between areas in the Namibian subsistence farming sector.\(^{123-128}\) This variation is likely to contain highly valuable genes for resistance to drought and salinity, especially in pearl millet.

Until recently, neither government nor private institutions gave much research or development attention to crop production. Crops in Namibia are cultivated mainly by subsistence farmers in northern regions. Since Independence, new research and development work has begun, mainly in the form of collaborative projects between Namibian and international organisations. Regionally, concern over the conservation of genetic resources was addressed in 1989 with the establishment of the SADC Plant Genetic Resources Centre Project (section 2.7) to conserve and utilise the region’s resources by *ex situ* and *in situ* methods.\(^ {104}\)

Other than watermelon *Citrus lanatus* (Box 2.9), none of the world’s major crops have centres of diversity within Namibia or southern Africa.\(^{129,130}\) Watermelons originated in Namibia and Botswana and are considered the region’s most important crop genetic resource. However, unusual regional genetic variation has also been found in other taxa, such as millet.\(^{131}\)

Aside from an unpublished paper\(^ {132}\) and short notices in various annual reports, there is no published literature on Namibian crop genetic diversity. The genetic diversity represented in the National Plant Genetic Resources Cen-
tre (NPGRC) has not yet been described, although the characterisation of this material started in 1995. From international principles and preliminary results, however, the following inferences can be cautiously made.

A great deal of genetic variability must exist in Namibian crops that have been cultivated in the country for many years. These are mainly the traditional crops of northern Namibian subsistence farmers (Box 4.7): pearl millet Pennisetum glaucum, sorghum Sorghum bicolor var. bicolor, groundnut Arachis hypogaea, Bambara groundnut Vigna subterranea, cowpea V. unguiculata, watermelon and others. This diversity is likely for three reasons. First, these crops have been grown in Namibia long enough to have developed distinct traits. Second, a degree of cultural isolation of crop farmers in the past, both from other countries and other areas of Namibia, could have enhanced the development of distinct local landraces. Third, a lack of 'improved' cultivars and the low priority given to agronomic research and development in the recent past must have allowed any distinct local landraces to be maintained. Indeed, modern agriculture in Namibia, as elsewhere, could be a major threat to this genetic diversity if there is insufficient appreciation of its value.

Differences in ecological conditions and cultivation practices within crop growing areas in Namibia seem to have produced different ecotypes. In controlled experiments, performance and morphological differences in Namibian landraces of pearl millet and sorghum could be linked to their areas of origin and cultivation. In general, genetic variation in crop plants is associated with their use and adaptation to habitat. Harlan suggests that on a global scale, the more marginal areas for cultivation contain less genetic variability, but study of more material from these regions is needed. For example, the cowpea is less variable in its centre of origin, southeast Africa, than in areas of more recent cultivation.

Inbreeding and outbreeding also have an effect on the genetic diversity of crops. Outbreeders are usually more heterozygous and polymorphic than are inbreeders. It can probably thus be assumed that pearl millet, an outbreeder, is genetically diverse because of its breeding system.

Crops grown in Namibia by commercial farmers are 'improved' varieties or cultivars. These must be genetically uniform to be registered. The genetic diversity of such crops within an area is thus assumed to be very low. There may be some genetic differences between areas due to the use of different cultivars.

Wild relatives of domesticated plants are numerous and diverse in Namibia. The genetic proximity of these species to the crop has not been well studied, and their agricultural value is mostly unknown. Several wild relatives, such as Citrullus lanatus and Vigna unguiculata, are regional endemics.

The ex situ conservation of domesticated plants in Namibia has been started with the establishment of the National Plant Genetic Resources Centre in 1993 (section 2.7). The pearl millet collection is fairly representative, but other crops require extensive collection (Table 2.15). It will take several more years to make the collection fairly representative. In situ or on-farm conservation of crop diversity has not yet been attempted in Namibia. This falls within the mandate of the NPGRC, but is so far prevented by lack of expertise and manpower.
Terrestrial and freshwater habitats

Genetic diversity is the basis for all advancement in agronomy.\textsuperscript{136,140,141} The adaptation of landraces of pearl millet to marginal and variable cultivation conditions has preserved genes enhancing drought tolerance. This is important nationally, regionally and globally, with droughts becoming a common occurrence. For increased food security, high yielding, locally adapted cultivars will be of vital importance. This potential is being used in the Sorghum and Millet Improvement Programme of SADC/ICRISAT. A Namibian Drought Tolerant Composite (NDTC) was formed from 400 collections in Namibia, and yielded some grain during the drought of 1991-92.\textsuperscript{133}

<table>
<thead>
<tr>
<th>Crop</th>
<th>No. of accessions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pearl millet</td>
<td>1010</td>
</tr>
<tr>
<td>\textit{Pennisetum glaucum}</td>
<td></td>
</tr>
<tr>
<td>Sorghum</td>
<td>126</td>
</tr>
<tr>
<td>\textit{Sorghum bicolor}</td>
<td></td>
</tr>
<tr>
<td>Groundnut</td>
<td>22</td>
</tr>
<tr>
<td>\textit{Arachis hypogaea}</td>
<td></td>
</tr>
<tr>
<td>Bambara groundnut</td>
<td>44</td>
</tr>
<tr>
<td>\textit{Vigna subterranea}</td>
<td></td>
</tr>
<tr>
<td>Cowpea</td>
<td>10</td>
</tr>
<tr>
<td>\textit{Vigna unguiculata}</td>
<td></td>
</tr>
<tr>
<td>Watermelon</td>
<td>63</td>
</tr>
<tr>
<td>\textit{Citrullus lanatus}</td>
<td></td>
</tr>
</tbody>
</table>

Table 2.15 Namibian crop accessions in the National Plant Genetic Resources Centre

Gaps and problems

The few small studies of genetic diversity in Namibian crops have been done on a morphological or performance basis.\textsuperscript{132-135} No molecular methods,\textsuperscript{142} which directly compare genetic diversity and eliminate environmental effects on gene expression, have been used. The NPGRC will over the next few years characterise germplasm morphologically, and has plans to use molecular methods. The current lack of competent staff is a severe constraint on these activities.

Recommendations

The following steps must be taken to obtain a clear understanding of crop genetic diversity in Namibia and its potential uses for the advantage of all Namibians:

- Ensure conservation of existing diversity through both \textit{ex situ} and \textit{in situ} methods to prevent any further loss of diversity;
- Characterise and evaluate local crops with morphological and molecular methods to establish genetic diversity patterns within Namibia, and later between Namibia and other regions;
- Develop the human resources capacity to achieve these aims.

— Herta Kolberg

Fig. 2.38 Millet genetic diversity is a focus of the NPGRC. Courtesy Ministry of Information and Broadcasting (N Akukothele)

Genetic diversity of wild animals

Little information exists on the genetic diversity of any wild animal in Namibia, with several important exceptions. Most genetic work concerns red data mammals, and is already generating valuable information. Box 2.10, for example, describes current work on carnivores in Etosha National Park which will yield genetic, ecological and behavioural data on lions, \textit{Panthera leo}. All of these forms of data can be essential for making informed management decisions, especially when conservation spending must be prioritised.