'Korona': the most important strawberry cultivar in Norway.

Raspberries and black currants had been mostly used for production of jam and juice by the industry. However, at the present time raspberry farmers grow more red raspberries for fresh consumption. Highbush blueberry production was established during the last 15 years, and is still only a small scale crop of about 25 hectares. Only areas in the Southern part of the country, with the best climatic conditions, are recommended for highbush blueberry production.

There is a long tradition of fruit and berry research at the Norwegian University of Life Sciences. Field trials, storage facilities and laboratories are placed on the Campus. Special focus has been on cultivars, quality, postharvest research and health beneficial compounds in fruits and berries (e.g. Heiberg et al., 1992; Haffner et al., 1997; Remberg et al., 2003, 2006).

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About the Authors

Karin Haffner

Siv Fagertun Remberg

Professor Dr. Karin Haffner, Norwegian University of Life Sciences, Dept. of Plant and Environmental Sciences, P.O. Box 5003, N-1432 Aas, Norway, email: karin.haffner@umb.no

PhD-student Siv Fagertun Remberg, email: siv.remberg@umb.no

Indigenous and Wild Cassava: A Rich Source of Genetic Diversity in Brazil

Nagib M.A. Nassar

Cassava (*Manihot esculenta*), a tuberous rootstock indigenous to Brazil, is now cultivated throughout the world's lowland tropics. It possesses many attributes such as efficient carbohydrate production, tolerance to low soil fertility, recovery from damage caused by pests and diseases, insurance against famine via underground conservation of roots for long periods, and adaptation to mixed cropping systems. It is the sixth major staple crop in the world after rice, wheat, maize, potato, and sweetpotato with annual production of 185 million tonnes (FAO, 2004). Africa is responsible for more than half of the world production, while Nigeria and Brazil account for about one third of the world production.

More than 700 million people consume cassava in one form or another. It is used for animal feed, and as a raw material for producing starch, starch-based products, and starch derivatives. Cassava starch is an important raw material in food processing, paper, textile and adhesive manufacturing and in the oil drilling

Figure 1. An indigenous cassava clone rich in beta-carotene.

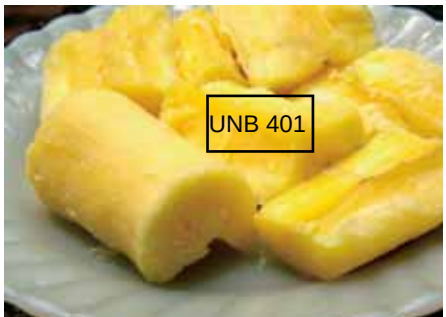

Figure 2. An indigenous cassava clone very rich in lycopene.

Figure 3. *M. oligantha.*

Figure 4. An interspecific hybrid of cassava with *Manihot pseudoglaziovii.*

industry. It is also a raw material for producing many derived sugar products, such as glucose, maltodextrines and mannitol.

An immense diversity of wild cassava and its indigenous clones is found in Brazil, its center of origin. Genetic resources of *Manihot* have been collected, evaluated and manipulated since the 1970s (Nassar, 1999). Genetic diversity of the wild species brought about by evolution and natural selection combined with domestication through thousands of years has led to the development of extremely valuable genetic resources. Screening indigenous clones enabled the selection of clones with high beta-carotene content (Fig. 1), as well as being rich in lycopene (Fig. 2) combined with increased palatability (Nassar et al., 2005). These clones have been propagated and distributed to farmers in the District Federal and adjacent states. A company has been formed to educate farmers and alert them to the nutritive value of these clones.

Figure 5. *M. pseudoglaziovii.*

Figure 7. An interspecific hybrid of cassava with *M. neusana.*

Wild species have also been manipulated. For example crosses of *Manihot oligantha* (Fig. 3), a source of high protein content, with cultivated cassava have produced a cultivar with 4% protein, twice the normal level (Nassar and Dorea, 1982). This hybrid has very high leaf protein reaching 9000 mg/kg compared to 700 mg/kg in common cultivars. Highly productive clones have been obtained through interspecific hybridization with wild species (Fig. 4). The use of certain wild species, namely *M. glaziovii*, *M. pseudoglaziovii* (Fig. 5) and *M. cearulescens* resulted in increased production of roots (Fig. 6) with yields 3 to 4 times higher than common cultivars including increases in vegetative growth (Fig. 7).

One of the most impressive examples of manipulating wild cassava is the production of cultivars resistant to bacterial blight and mosaic achieved by S.K. Hahn, IITA, using some of this material. These cultivars are cultivated on more than 2 million hectares in Nigeria. Wild cassava may offer genes for apomixis, which will enable clones to be progagated by seed (Nassar, 2000).

Figure 6. A selection from a cassava-*Manihot cearulescens* hybrid.

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About the author

Nagib N.A. Nassar

Nagib Nassar is professor in the Departament of Genetics, University of Brasilia, Brazil. He is holding a 5-year-old plant of *Manihot glaziovii*. Email: nagnassa@rudah.com.br