Vol. 6: 153–155, 1996 | CLIMATE RESEARCH Clim Res | Published February 19

Alternative food crops to adapt to potential climatic change in southern Africa

Wilberforce Kamukondiwa

Scientific and Industrial Research and Development Centre, Environment and Remote Sensing Institute, PO Box 6640, Harare, Zimbabwe

ABSTRACT: This paper discusses the merits of an alternative food crop, cassava *Manihot esculenta*, as a means to alleviate the effects of climate-induced drought on human and livestock food security in southern Africa. Although both tubers and leaves of cassava can be processed for consumption, the crop is grown to a very limited extent in this region. However, local awareness of cassava's potential has increased over the last decade.

KEY WORDS: Agriculture · Adaptation · Cassava

INTRODUCTION

General Circulation Models suggest that climate change scenarios of warmer and drier conditions may significantly reduce yields of agronomic crops in southern Africa (Makadho 1992). Sustainable agriculture under a warmer and drier climate requires proper choice of plants with high water-use efficiency (WUE) and the capacity to maintain production at high ambient CO_2 concentrations (Rosenzweig & Parry 1994). Cassava *Manihot esculenta*, which is already widely grown elsewhere in Africa (Carter et al. 1992), is a C_3 root crop that is highly drought-tolerant. The objective of this report is to review the potential of cassava as an alternative crop in the event of rapid climate change impacts in southern Africa.

HISTORY AND BACKGROUND OF CASSAVA IN SOUTHERN AFRICA

Cassava is a potentially high yielding root crop of South American origin. It was introduced into Africa by Portuguese traders during the sixteenth century and into Zimbabwe from Angola, Malawi, Mozambique, Zaire and Zambia (Carter et al. 1992). No specific production skills are required to grow cassava, which tolerates drought, acidity and low soil fertility (Asher et al. 1980, Hahn et al. 1987). As such, the crop often became an important source of food in African communities where war once disrupted farming activities (Carter et al. 1992). However, most varieties of cassava need adequate processing to eliminate cyanide (CN), which may lead to disorders of iodine deficiency and paralytic conditions in consumers (Hahn et al. 1987, Banea 1993). Processing requires that cassava be peeled, soaked, fermented and boiled to evaporate HCN. The tubers can also be dried and ground before cooking. A level of 10 mg CN kg^{-1} after processing is considered safe for consumption (Banea et al. 1992) although for infants it is safer to require even lower limits. Cassava tubers are highly perishable and require processing within days of harvesting.

The potentially high yields of cassava (up to 50 Mg ha^{-1}, or approximately 20 Mg ha^{-1} dry mass basis; Pakpahan et al. 1993) can guarantee farmers food from small cropped areas, leaving a larger hectarage for crops with high income potential. In high rainfall areas, production of food crops can be increased through cassava-corn (*Zea mays* L.) intercropping, which also improves the efficiency of energy utilization (through increased leaf area index) and reduces weeds by providing a more closed crop canopy. With a comparatively lower resource cost, cassava produces more than twice the calories per hectare produced by corn (Hahn et al. 1987).

The projected mean cassava yield of 15 Mg ha^{-1} (about 5 Mg ha^{-1} dry mass basis) for Zimbabwe (Kleih

1994) far exceeds the Zambian national average of 6 Mg ha^{-1} fresh tubers (Makadho 1992). These yields also compare favorably to corn yields of <1.5 Mg ha^{-1} obtained in Chivi. Adoption of cassava by communal farmers in some regions of Zimbabwe would reduce government expenditure on food rations and contribute to a saving of the much needed foreign currency. Corn, the staple food crop of Zimbabwe, is a risky crop because successful grain yields depend on the availability of adequate moisture during pollination and grain-filling periods (Makadho 1992). Rainfall is low and unreliable in the corn producing regions. This situation is further compounded by an apparent climatic shift towards drought in Zimbabwe, whereby the last 15 yr have had only 2 good rainy seasons that produced bumper harvests (Unganai 1996). Drought tolerant cassava may be an acceptable alternative crop.

CASSAVA AS A FOOD AND FODDER CROP

A dearth of knowledge about the processing of cassava, and fears of CN poisoning, are factors restraining the cultivation of cassava in southern Africa. In addition, priorities have been placed on other crops such as corn. However, a national program is now in place to increase research on cassava and also awareness about the benefits of this crop among farmers. Communal area farmers would be willing to grow cassava if they were assured of a viable market for the crop (Kleih 1994). However, there is no agro-industry that has committed itself to buy cassava for any purpose in southern Africa. As such, the decision to grow cassava would be purely for the purpose of local consumption as farmers cannot make an economic decision in the absence of an expected producer price.

Apart from subsistence, cassava may have industrial uses as fodder, in brewing beer, and in the production of ethanol and butanol for blending with petrol and diesel. Cassava leaves containing about 26% protein on a dry weight basis are eaten as a green vegetable in many parts of Africa (Hahn et al. 1987). The livestock feed industry was identified as the largest potential market, with cassava envisaged to supersede corn (Kleih 1994). However, the low protein content of the tubers will require supplementary protein sources such as soyameal or cassava leaves. Other proposed uses of cassava include the manufacture of industrial starch and adhesives.

The customary cultivation of cassava in most regions of the world does not involve use of chemical inputs (Asher et al. 1980). Intensive use of fertilizers can lead to greenhouse gas emissions (Duxbury 1994). However, commercial production of cassava certainly requires breeding for the desired qualities, and the use of minimal agricultural inputs. Whereas the threat of viruses is often thought to be less when propagation of cassava is done by seed, vegetative propagation is most common (Iglesias et al. 1994). Apart from pests, diseases and severe nutrient deficiencies, reduction in yield can also result from decay of tubers under excessive soil moisture. Such decay was observed on the vertisol soils of Chisumbanje when cassava grown on flat land was irrigated. Where drainage is poor, cassava is normally planted on ridges (Pellet & El-Sharkawy 1994) to avoid decay of tubers.

CONCLUSION

The benefits of cassava as a food and fodder crop are fairly well understood and can be realized if adequate processing is done before consumption. Local research on tuber and biomass yield of cassava under variable temperature, solar radiation and CO_2 concentration could improve knowledge on the vulnerability and adoption of cassava in southern Africa under changing climatic conditions.

Acknowledgements. Dr L. T. Gono, Mr V. Mabika, and Mrs D. Hikwa allowed access to literature resources, and Mr E. T Gwata of the Crop Breeding Institute, Harare, made several constructive comments.

LITERATURE CITED

Asher CJ, Edwards DG, Howeler RH (1980) Nutritional disorders of cassava. St. Lucia, Queensland

Banea M (1993) Cassava processing, dietary cyanide exposure and konzo in Zaire. Master's thesis, Uppsala University

Banea M, Poulter NH, Rosling H (1992) Shortcuts in cassava processing and risk of dietary cyanide exposure in Zaire. Food Nutrition Bull 14:137–143

Carter SE, Fresco LO, Jones PG (1992) An atlas of cassava in Africa. Historical, agroecological and demographic aspects of crop distribution. CIAT, Cali, Colombia

Duxbury JM (1994) The significance of agricultural sources of greenhouse gases. Fertilizer Res 38:151–163

Hahn SK, Mahungu NM, Otoo JA, Msabaha MAM, Lutaladio NB, Dahniya MT (1987) Cassava: an alternative crop. In: Terry D et al. (eds) Tropical root crops: root crops and the African food crisis. International Society for Tropical Root Crops — Africa Branch. Proceedings of the Third Triennial Symposium held in Owerri, Nigeria, 17–23 August 1986. Publ No 258e, IDRC, Ottawa, p 24–29

Iglesias C, Hershey C, Calle F, Bolanos A (1994) Propagating cassava by sexual seed. Exp Agric 30:283–290

Kleih U (1994) Feasibility study of cassava production and marketing in Zimbabwe. Natural Resources Institute, London

Makadho J (1992) Smallholder irrigation in communal areas. In: Whingwiri et al. (eds) Small-scale agriculture in Zimbabwe. Farming Systems, Policy and Infrastructural Development. IDRC, Ottawa, p 50–63

Pakpahan A, Pasaribu SM, Djauhari A, Nasution A (1993) Cassava marketing system in Indonesia. Indon Agric Res Dev J 15:52–69

Pellet D, El-Sharkawy MA (1994) Sink-source relations in cassava: effects of reciprocal grafting on yield and leaf photosynthesis. Exp Agric 30:359–367

Rosenzweig C, Parry ML (1994) Potential impact of climate change on world food supply. Nature 367:133–138

Unganai LS (1996) Historic and future climatic change in Zimbabwe. Clim Res 6:137–145