

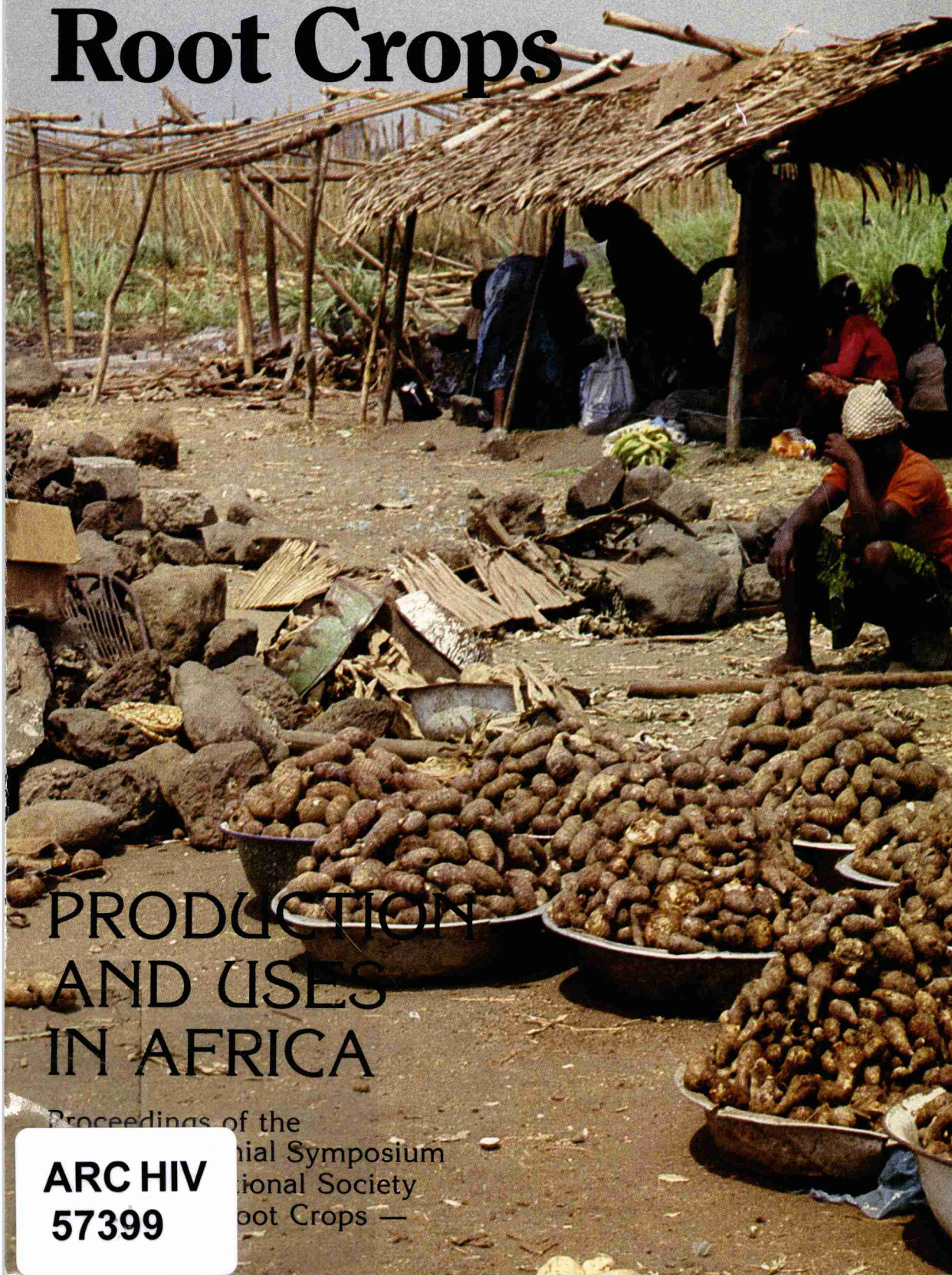
57399

Tropical Root Crops

PRODUCTION AND USES IN AFRICA

Proceedings of the
International Symposium
International Society
Root Crops —

ARCHIV
57399



The International Development Research Centre is a public corporation created by the Parliament of Canada in 1970 to support research designed to adapt science and technology to the needs of developing countries. The Centre's activity is concentrated in five sectors: agriculture, food and nutrition sciences; health sciences; information sciences; social sciences; and communications. IDRC is financed solely by the Parliament of Canada; its policies, however, are set by an international Board of Governors. The Centre's headquarters are in Ottawa, Canada. Regional offices are located in Africa, Asia, Latin America, and the Middle East.

The International Society for Tropical Root Crops — Africa Branch was created in 1978 to stimulate research, production, and utilization of root and tuber crops in Africa and the adjacent islands. The activities include encouragement of training and extension, organization of workshops and symposia, exchange of genetic materials, and facilitation of contacts between personnel working with root and tuber crops. The Society's headquarters are at the International Institute of Tropical Agriculture in Ibadan, Nigeria, but its executive council comprises eminent root and tuber researchers from national programs throughout the continent.

© International Development Research Centre 1984
Postal Address: Box 8500, Ottawa, Canada K1G 3H9
Head Office: 60 Queen Street, Ottawa, Canada

Terry, E.R.
Doku, E.V.
Arene, O.B.
Mahungu, N.M.

International Society for Tropical Root Crops. Africa Branch, Ibadan NG

IDRC-221e

Tropical root crops: production and uses in Africa : Proceedings of the second Triennial Symposium of the International Society for Tropical Root Crops — Africa Branch held in Douala, Cameroon, 14–19 August 1983. Ottawa, Ont., IDRC, 1984. 231 p.: ill.

/Cassava/, /root crops/, /plant production/, /Africa/ — /genetic improvement/, /planting/, /plant diseases/, /pests of plants/, /intercropping/, /fertilizers/, /crop yield/, /sweet potatoes/, /plantains/, /agriproduct processing/, /nutritive value/, /food enrichment/, /feed/, /agricultural research/, /conference report/, /list of participants/.

UDC: 633.68

ISBN: 0-88936-409-5

Microfiche edition available.

Il existe également une édition française de cette publication.

TROPICAL ROOT CROPS: PRODUCTION AND USES IN AFRICA

Archiv
633.68
I 5
1983

ABSTRACT

A mixture of original research, updates on procedures, literature reviews, and survey reports, this document resulted from the second symposium of the International Society for Tropical Root Crops — Africa Branch, with 77 participants from 16 countries. The focus was cassava, yams, cocoyams, and sweet potatoes, from the perspectives of breeders, agronomists, soil specialists, plant pathologists, entomologists, nutritionists, food technologists, etc. Learning from past successes and failures, many of the researchers directed their efforts toward problems obstructing progress in reaching improved production and use of root crops and attempted to view, realistically, the context in which their results would be applied.

RÉSUMÉ

Résultats de recherches récentes, mises à jour sur les méthodes de recherche, revues de publications et rapports de sondages sont contenus dans ce document issu du Deuxième symposium de la Société internationale pour les plantes-racines tropicales — Direction Afrique, qui a réuni 77 participants de 16 pays. Des communications sur le manioc, le taro, le yam et la patate douce ont été présentées par des phytosélectionneurs, des agronomes, des pédologues, des phytopathologistes, des entomologistes et des spécialistes de la nutrition et des aliments, entre autres. Tirant leçon de leurs succès et de leurs échecs, beaucoup de ces chercheurs ont dirigé leurs efforts vers la solution des problèmes qui entravent l'augmentation de la production et de la consommation des plantes-racines et ont tenté de considérer d'un œil réaliste le contexte qui sera celui de l'application de leurs recherches.

RESUMEN

Una mezcla de investigaciones originales, actualizaciones de procedimientos, reseñas de literatura e informes de encuestas, este documento es el resultado del segundo simposio de la Sociedad Internacional de Raíces Tropicales, Filial Africana, que contó con 77 participantes de 16 países. El simposio se centró en la yuca, el ñame, el cocoñame y las batatas, desde la perspectiva de los fitomejoradores, los agrónomos, los especialistas en suelos, los patólogos vegetales, los entomólogos, los nutricionistas, los tecnólogos alimenticios, etc. A partir de los éxitos y fracasos anteriores, muchos de los investigadores encaminaron sus esfuerzos hacia los problemas que obstaculizan el avance para lograr una producción y un uso mejorados de las raíces y trataron de obtener una visión realista del contexto en que los resultados pueden ser aplicados.

TROPICAL ROOT CROPS: **PRODUCTION AND USES IN AFRICA**

EDITORS: E.R. TERRY, E.V. DOKU, O.B. ARENE, AND N.M. MAHUNGU

*PROCEEDINGS OF THE SECOND TRIENNIAL SYMPOSIUM OF THE INTERNATIONAL
SOCIETY FOR TROPICAL ROOT CROPS — AFRICA BRANCH HELD IN DOUALA,
CAMEROON, 14 – 19 AUGUST 1983*

CONTENTS

<i>Foreword</i>	9
<i>Participants</i>	11
<i>Official addresses</i>	
Opening address Nkaifon Perfura	15
Presidential address Bede N. Okigbo	16
Closing address Nkaifon Perfura	17
<i>Introduction</i>	
Production potentials of major tropical root and tuber crops E.V. Doku	19
Potential utilization of major root crops, with special emphasis on human, animal, and industrial uses D.G. Coursey	25
<i>Cassava</i>	
Genetic parameters of cassava N.M. Mahungu, H.R. Chheda, S.K. Hahn, and C.A. Fatokun	37
Evaluation of cassava clones for leaf production in Zaire N.B. Lutaladio	41
Cassava screening in Rwanda J. Mulindangabo	45
Effect of variety and planting time on the yield of cassava in Malawi R.F. Nembozanga Sauti	49
Response of cassava to fertilizers and town refuse under continuous cropping S.O. Odurukwe and U.I. Oji	51
Rapid multiplication of cassava by direct planting M.T. Dahniya and S.N. Kallon	53
Effects of shade, nitrogen, and potassium on cassava I.N. Kasele, S.K. Hahn, C.O. Oputa, and P.N. Vine	55
Weed interference in cassava-maize intercrop in the rain forest of Nigeria Ray P.A. Unamma and L.S.O. Ene	59
Crop performance in complex mixtures: melon and okra in cassava-maize mixture J.E.G. Ikeorgu, T.A.T. Wahua, and H.C. Ezumah	63
Soil-conserving techniques in cassava and yam production P.N. Vine, O.B. Ajayi, D.M. Mitchozounou, E.J. Hounkpatin, and T. Hounkpevi	67
Factors limiting cassava production among peasants in Lukangu, Zaire Kilumba Ndayi	71
Epidemiology of anthracnose in cassava C. Makambila	73

Cassava yield losses from brown leaf spot induced by <i>Cercosporidium henningsii</i> J.M. Teri, P.W. Mtakwa, and D. Mshana	79
Susceptibility of cassava to <i>Colletotrichum manihotis</i> Muimba-Kankolongo A., M.O. Adeniji, and E.R. Terry	82
<i>Botryodiplodia</i> stem rot of cassava and methods of selecting varieties for resistance G.W. Otim-Nape	86
Distribution and severity of cassava mosaic in the Congo R. Massala	89
The cassava mealybug front hypothesis: role of indigenous natural enemies K.M. Lema, R.D. Hennessey, and H.R. Herren	90
Comparative bioecology of two coccinellids, predators of the cassava mealybug, in the Congo G. Fabres and A. Kiyindou	93
Effects of fertilizer application on postembryonic development and reproduction of the cassava mealybug K.M. Lema and N.M. Mahungu	97
Functional response of <i>Amblyseius fustis</i> to increasing density of its prey <i>Mononychellus tanajoa</i> T.O. Ezulike and J.K.U. Emehute	99
Control of the cassava green mite in Uganda B. Odongo and G. W. Otim-Nape	101
Studies on the nutrient content of yellow-pigmented cassava O. Safo-Kantanka, P. Aboagye, S.A. Amartey, and J.H. Oldham ..	103
Microbial breakdown of linamarin in fermenting cassava pulp M.A.N. Ejiofor and Nduka Okafor	105
Performance of a cassava peeling machine P.M. Nwokedi	108
An improved technique of processing cassava fufu Festus A. Numfor	111
Cassava-based diets for rabbits R.T. Fomunyam, A.A. Adegbola, and O.L. Oke	114
Effects of cassava meal on the hatchability of chicken eggs D.A. Ngoka, E.C. Chike, A.B. Awoniyi, T. Enyinnia, and S.O. Odurukwe	117
Yams	
In-vitro culture of <i>Dioscorea rotundata</i> embryos C.E.A. Okezie, F.I.O. Nwoke, and S.N.C. Okonkwo	121
Economic indices for clonal selection and breeding of yams O.O. Okoli, J.U. Nwokoye, and C.C. Udugwu	125
Seed-yam production M.N. Alvarez and S.K. Hahn	129
Natural antifungal compounds from the peel of yam tubers S.K. Ogundana, D.T. Coxon, and C. Dennis	133
Optimal time for fertilization of <i>Dioscorea rotundata</i> S.C.O. Nwinyi ..	136
Effects of staking on tuber yield of three cultivars of trifoliate yam S.N. Lyonga and J.T. Ambe	138
Effect of time of staking on the development of anthracnose disease of water yam A.O. Nwankiti and I.U. Ahiara	140
Thermodynamics applied to the storage of yam tubers Godson O. Osuji	143
Root-knot susceptibility of crops grown with yam in Nigeria U.G. Atu and R.O. Ogbuji	147
Effects of cover plants on root-knot nematode population U.G. Atu and R.O. Ogbuji	149
Survival of <i>Botryodiplodia theobromae</i> in yam tissues B.I. Aderiye and S.K. Ogundana	151

Variability in the chemical composition of yams grown in Cameroon T. Agbor Egbe and S. Treche	153
Mineral content of yam tubers: raw, boiled, and as flour A. Bell	157
Introduction of flour from <i>Dioscorea dumetorum</i> in a rural area G. Martin, S. Treche, L. Noubi, T. Agbor Egbe, and S. Gwangwa'a	161
<i>Cocoyams, Sweet Potatoes, and Others</i>	
In-vitro methods for cocoyam improvement E. Acheampong and G.G. Henshaw	165
Production of hybrid <i>Xanthosoma sagittifolium</i> and test for resistance to <i>Pythium myriotylum</i> A. Agueguia and S. Nzietchueng	169
Growth and development of <i>Colocasia</i> and <i>Xanthosoma</i> spp. under upland conditions M.C. Igbokwe	172
Effects of water-table depth on cocoyam B.S. Ghuman and R. Lal	175
Intercropping cocoyams with plantain: effects on the yield and disease of cocoyams M.C. Igbokwe, O.B. Arene, T.C. Ndubizu, and E.E. Umana	182
Root rot of <i>Xanthosoma sagittifolium</i> caused by <i>Pythium myriotylum</i> in Cameroon Samuel Nzietchueng	185
Sweet-potato production potential in Rwanda G. Ndamage	189
Compartment studies with sweet potatoes in the highland zone of Cameroon S.N. Lyonga and J.A. Ayuk-Takem	192
Effects of vesicular-arbuscular mycorrhizae, temperature, and phosphorus on <i>Fusarium</i> wilt of sweet potato J.M. Ngeve and R.W. Roncadori	197
On-farm trials as a link between research and technology transfer H.J. Pfeiffer	203
Plantain in root-crop farming systems S.K. Karikari	206
References	209
<i>Abstracts</i>	
Yellow-pigmented cassava revisited K.A. Oduro	229
Distribution and utilization of cassava in Malawi R.F. Nembozanga Sauti	229
Can cassava productivity be raised in Zambia? N. Hrishu	230
Prospects for developing new white yam varieties M.O. Akoroda	230
Extension of root-crops technology to African farmers T. Enyinnia, H.E. Okereke, and D.A. Ngoka	231

PERFORMANCE OF A CASSAVA PEELING MACHINE

P.M. NWOKEDI¹

Peeling constitutes a major problem in cassava processing in Nigeria. At present, the method of peeling is usually manual. This paper discusses the development, design, and manufacture of a peeling machine suitable for village use. The machine is an oval chamber that has holes cut along the walls and is lined with sharp wire gauze. Cassava roots are loaded in the chamber, which is mounted on two mild-steel rods, 35 cm in diameter, attached at either end. The rods allow the chamber to rotate clockwise. The left rod is connected to a 5-hp electric motor by means of a v-belt pulley. Thirty balls coated with wire gauze are added to the chamber. The machine is mounted on an angle — 33°. The angle permits the sharp edges of the chamber and balls to carry out effective abrasive peeling. The roots are cleaned as they are being peeled, the chamber passing through a water-filled pan underneath it.

Peeling is the most labour-intensive operation in processing cassava for use in traditional dishes in Nigeria. At present, peeling is done by hand. A peeling machine suitable for use at the village level would alleviate the drudgery involved in cassava processing and open the way for processing on a larger scale than household production. This thinking prompted my colleagues and me at the National Root Crops Research Institute (NRCRI) to design, manufacture, and test such a machine.

In designing the machine, we had to allow for the many variations in size and shape of roots from current varieties of cassava. The weight

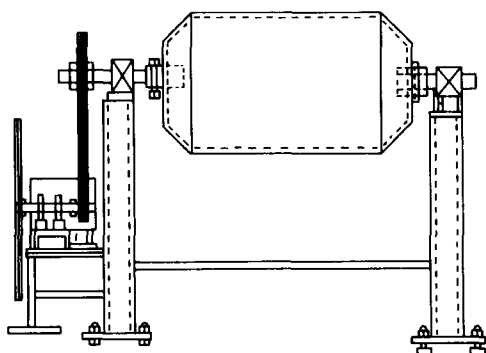


Fig. 1. Front view of cassava peeler.

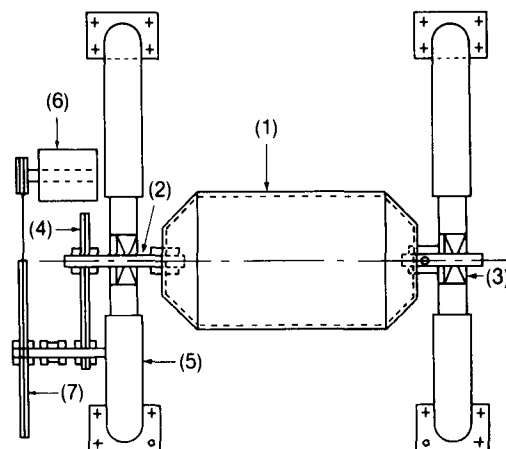
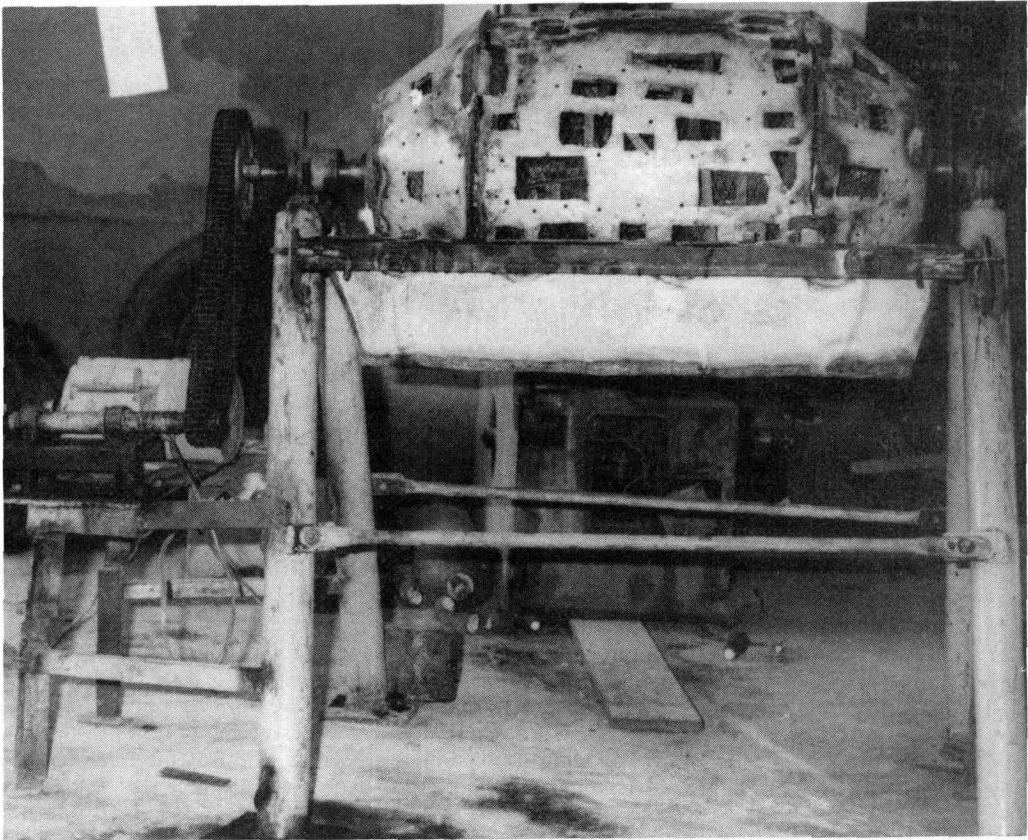


Fig. 2. Plan for cassava peeler: (1) chamber, (2) support shaft, (3) roller bearing, (4) sprocket/chain, (5) frame, (6) electric motor, (7) pulley.

varies between 30 g and 400 g and there are spindle-shaped and carrot-like roots. The peels also vary in thickness, texture, and strength of adhesion to the root's flesh. The properties vary with the age of the roots both before and after harvest. Our task, therefore, was to design a peeling machine that would handle any roots from any source all year round.

Within these constraints, we devised a simple machine, an egg-shaped cylinder with an inner chamber or lining of sharp wire gauze. The cylinder has holes cut in the walls so that when it

¹ National Root Crops Research Institute, Engineering Research Department, Umudike, Umuahia, Nigeria.



The peeling machine is functional, simple to assemble, and inexpensive.

rotates through a water-filled pan mounted below it, the water passes through the holes to wash the roots. The cylinder is supported on 35-cm-diameter mild-steel pipes, attached at both ends. These pipes serve as short shafts that allow the cylinder to rotate clockwise. The left shaft is connected to a 5-hp diesel engine by means of a v-belt pulley. The chamber contains 30 balls that are also coated with wire gauze. The machine is mounted at an angle of 33°; in this position, the sharp-edged chamber and the balls carry out effective abrasive peeling of the cassava roots. The chamber rotates through the pan containing water. It can peel 300 kg of roots at one time. There are two protective galvanized plates that are attached to the sides of the water-pan to prevent water from spreading.

PERFORMANCE TESTS

We tested the performance of the cassava peeling machine with roots harvested from

Western Farm (NRCRI). We divided 3000 kg roots into three batches — one batch was peeled that day, a second batch was peeled the next day, and the third batch was peeled by hand (the traditional method). All the roots were weighed before being peeled. Three persons performed the manual operation. Both the machine and manual operations were timed, and the peeled roots were weighed. Another series of tests were undertaken with 1000 kg roots, but this time the roots were cut into straight pieces and sorted by size — small, medium, and large — before being peeled by the machine.

RESULTS AND DISCUSSION

Naturally, the ideal is that the machine will remove the peel completely without removing useful flesh (Odigboh 1978). Unlike yams or other tuber crops, the cassava has roots with a relatively loose peel or cortex. Hand-peeled roots average about 80% of the total weight of

unpeeled roots, that is, the peelings constitute about 20% of the total weight.

When the unsized sample was mechanically peeled, the weight of the sample was considerably lower than the hand-peeled control. The small roots were peeled before the large ones and had disappeared completely by the time the larger roots were peeled.

To quantify the performance based on the ratio of peeled and unpeeled roots, we used the equation $E = W - W_a/W - W_e$ where E was peeling efficiency index; W was mass of unpeeled roots; W_a was actual mass of peeled roots; and W_e was mass of peeled roots that would be obtained if only the cortex were removed ($0.95 - 1.8 W$). The closer the value is to 1.00, the higher the peeling efficiency. E , when less than 1.00, corresponds to incomplete peeling. E greater than 1.8 indicates loss of useful root flesh.

The peeling machine was least efficient when handling unsized roots — 45%; hand trimming was necessary. In samples that were separated by size, some hand trimming was also necessary for the small roots, but the efficiency improved to 68%.

Performance was observed to be best for the medium and large roots, peeling being complete and the losses of flesh negligible. If not excessive, flesh loss is better than hand trimming,

which is time-consuming. In addition, the machine efficiency was improved when the balls in the machine were various sizes.

The three people peeling roots by hand were able to peel 300 kg/day. Their peeling rate was lower on the 2nd and 3rd days than on the 1st day, probably because the roots dried out enough to make peeling by hand more difficult. The throughput in mass/unit time depends on the root sizes, with higher rates for larger roots. The machine's rate for unsized roots was 15 kg/h, whereas, for sized samples, was as high as 500–1000 kg/25 minutes. However, this rate does not include the time spent in cutting the cassava roots into straight chunks about 80–100 mm or sorting the cut pieces.

CONCLUSION

The cassava peeling machine has been perfected by the NRCRI for the past 3 years. The completion of the machine is planned this year. The peeler functions best with sized lots of cassava; when set up for a specific size range, it has a peeling efficiency of up to 80%. Because the cutting and sorting are time-consuming, the machine needs to be carefully adjusted to peel at maximum efficiency to offset the time and labour and to avoid hand trimming.