Journal of Agriculture, Pure and Applied Science and Technology ISSN 2073-8749
Printed by Moi University Press

Germplasm Selection in Private Tree Nurseries: A Case Study of Western Kenya

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J. agric. pure appl. sci. technol. 5, 15- 21 (2010); received November 20, 2009/April 17, 2010

The study to determine source of tree germplasm was carried out in Bungoma District, Western Kenya. Private tree nursery operators were identified through a reconnaissance survey: They were then subdivided based on the Agro-ecological zones. A random sample proportional to size was then drawn from the tree nurseries identified in each zone. The sampled private tree nursery operators were then interviewed using a questionnaire .The data obtained was then subjected to analysis using the SPSS package.

The results indicated that only about 10% of the operators used germplasm from certified sources, most tree nursery operators (82%) obtained germplasm from their farms, more than 70% of the selection was based on characteristics such as stem form, attractiveness of the trees, growth rate, fruit quality, resistance to pests and diseases, ecological zone and maturity. However, less than 5% took into consideration other characteristics such as shading of leaves and flowers, wood quality, fruit size, resistance to wind damage, scent produced by the trees, ability to flower and hold flower to fruit production stage, compatibility with crop and harboring of caterpillars and other harmful pests. More than 85% of the tree nursery operators did not take into consideration the number of mother trees, distance between mother trees and the appearance of trees near the mother tree in selecting germplasm sources. Germplasm were collected from single tree sources.

It was found that most germplasm was collected locally, without any regard to genetic quality. This has resulted in production of poor seedlings of the subsequent generations. It is concluded that small-scale tree nurseries and their managers had an important role in ensuring sustainable development of rural communities in Bungoma district. It is essential that they obtain access to the knowledge, skills and resources necessary to maintain and enhance their capacity to produce seedlings which form an integral part of the local agroforestry systems.

Key words: Germplasm, selection, Genetic quality, Agroforestry and Phenotype

Introduction

Seedling production is an integral part of most tree planting programmes .Lack of seed and seedlings constitute a serious constraint for smallholders to fully utilize the benefits of trees (ICRAF, 2000; Johansson & Westman, 1992; Aalbæk, 2001). Even when planting material is available, it is often insufficient with regard to genetic and physiological quality. It is important to use quality tree planting material for several reasons. First, the physiological quality of seeds and seedlings affects the success of establishment and the subsequent growth rate of the plant. Second, genetic quality is of great economic consequence (Foster, Jones and Kjær, 1995). The chosen material should be selected to suit local conditions and should be of sufficient genetically broad origin to ensure the stability, e.g. resistance against pests and diseases of the planted trees. Using quality plant material is one important avenue to ensure that farmers and other tree planters will gain from plant (Kjaer & Nathan, 2000).

Traditionally farmers have been using a large variety of plants which were growing in their natural environment requiring little management. However, in present landscapes with diminishing natural ecosystems and indigenous plant populations farmers have to plant trees to meet their needs for food fodder, timber, and medicine and other products and services (Kindt and Lengkeek , 1999), such efforts are only successful if germplasm of high genetic quality is available (Simon ,1999), O connor (1997) , Holdimg and Omondi ,1998 revealed that majority of new planting stock on farms came from farmer's own farms and that quality germplasm of many species is not available .Moreover, the number of mother trees used is limited.

Germplasm sources are places or trees from which germplasm is collected .Good tree germplasm sources provide fast growing, healthy, genetically diverse planting material. Germplsm of good genetic quality is crucial to successful Agroforestry systems Kindt et al,.2006), they determine the efficiency of the seed supply system and maintenance of genetic quality. Inferior quality germplasm have been introduced in Agroforestry systems resulting into long term negative effects on genetic quality in materials available to farmers Holding and Omondi, 1998, hence need to investigate on germplasm sources in order to take corrective measures in good time.

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Materials and Methods

Study area

The study was carried out in Bungoma District in western Kenya which lies between latitudes 0º 25.3'N and 0º 53.2'N and longitudes 34º 21.4'E and 35º 04'E, at a latitude of between 1200 m-2100 m above the sea level.

Sampling techniques

Private tree nurseries in Bungoma District were identified through a reconnaissance survey and were then subdivided basing on the agro-ecological zones. A random sample proportional to size was then drawn from the tree nurseries identified in each zone. The sampled private tree nursery operators were then interviewed using a Questionnaire .The data obtained was then subjected to analysis using the SPSS package.

Results

Kind of propagation material used

Private tree nursery operators in Bungoma district use three main kinds of propagation material , these are seeds, wildlings and vegetative propagation material , out of the three main kinds of germplasm , seeds were exclusively used by 72% of the operators , 24% however use a combination of seeds and vegetative propagation material. a few operator use wildlings.

Selection of germplasm sources

The selection of Germplasm sources is based phenotypic characteristics(85%).More than 75% of the selection of germplasm sources was based on phenotypic characteristics such as stem form ,attractiveness ,productivity ,growth rate, fruit quality, resistance to pests and diseases and maturity of the tree. However less than 5% took into consideration other characteristics such as shading of leaves and flowers, wood quality, fruit size, resistance to wind damage, scent produced by the trees, ability to flower and hold flower to fruit production stage, compatibility with crop and harboring of caterpillars and other harmful pests. On the contrary, 10% collect germplasm from any tree that has sufficient quantity without taking into consideration any desired characteristics.

Criteria for increasing genetic diversity

On the other hand more than 85% of the tree nursery operators do not take into consideration the number of mother trees, distance between mother trees and the appearance of trees near the mother tree in selecting germplasm sources. They collect germplasm from singlet tree sources as long as they can obtain sufficient quantities.

Sources of germplasm

These are places where the germplasm is obtained. Farms (82%) are the major sources of germplasm used by most tree nursery operators. Other important germplasm sources are Kenya Forest service 14% Divisional officer and Non Governmental Organizations (12%) such as VI _ agroforestry and Green Belt Movement (Fig. 1)

Germplasm source	Percentage of (Yes%) Responses
Farmland	82
Natural forest	4
Kenya Forest Service	14
Ministry of Agriculture	7
Agricultural research	4
Forest research	6
NGOs	12
Seed dealers	3
Other nurseries	1
Planted seed orchards	1
British American Tobacco	3
Friends	1
Forest plantations	2

Fig 1 . Sources of germplasm

Discussion

Most tree nursery operators in Bungoma District raised their seedlings exclusively from seeds. They seemed to be unaware of vegetative propagation techniques and their importance. Most germplasm is collected locally within their farms giving an assurance that that the germplasm is well adapted to the environmental conditions of the planting site, they of desired species could be obtain at the right time without inconveniences and germplasm can be acquired at less expensively (Tengnas, 1994). Selection of mother trees was based on desired phenotypes. Trees with superior trait as regards stem form, attractiveness of the trees ,growth rate, fruit quality ,resistance to pests and diseases and maturity were selected in selecting the tree from which they obtained germplasm. However less than 5% , take into consideration other characteristics such as shading of leaves and flowers, wood quality, fruit size, resistance to wind damage, scent produced by the trees, ability to flower and hold flower to fruit production stage, compatibility with

crop and harboring of caterpillars and other harmful pests. On the contrary, 10% collect germplasm from whatever tree that has seed s with out taking into account any desirable characteristic of the tree.

The criteria for increasing genetic diversity were however not taken care of in selection of mother trees , these is contrary to the standardized collection procedure of Dawson and Were (1997) which recommends that germplasm should be collected from a minimum of 30 mother trees ,from trees that are 50-100M apart. On the contrary Germplasm was collected from an average of 1.30 mother trees ,from trees within an average on 0.0325Km apart, they were not bothered with appearance of trees near the mother tree in selecting germplasm sources despite the fact that such trees could be potential pollinators of the selected mother trees and should be of superior phenotypes Kindt *et al*., (2006) .They collect germplasm from single tree sources as long as they can obtain sufficient quantities of germplasm .Germplasm used in most tree nurseries is insufficient with regard to genetic quality and could lead to genetic diversity degradation in the future generations . Genetic diversity is being desired because it offers protection against future unforeseen calamities such as pest outbreaks and changes in weather conditions.

Conclusion

Most germplasm was collected locally with farms. Most germplasm was selected based on superior phenotypes as regard stem form, attractiveness productivity, growth rate, fruit quality, resistance to pests and diseases and maturity. The germplasm collected was insufficient with regard to genetic quality particularly genetic variability with in the species.

References

Aalbæk, A., (2001), Farmers' tree planting and access to germplasm in the southern highlands of Tanzania. Unit of Forestry ,Department of Economics and Natural Resources, Royal Veterinary and Agricultural University, Copenhagen. In press .

DFSC, (2000), Challenges and Priorities in Management of Forest Genetic Resources 2000-2005, Danida Forest Seed Centre.

Edwards, D. and K. Schreckenberg, (1997), Demand from Smallholder Farmers for Multipurpose Tree Germplasm. Implications for Policy, Research, and Development. Advance proceedings of the International Workshop on Policy Aspects of Tree Germplasm Demand and Supply organized at ICRAF, Nairobi, Kenya, 6-8 October 1997.

Foster, G.S.; Jones. N. & Kjær, E.K. (1995), Economics of tree improvement in developing projects in the tropics. In: Environmental & economic issues in forestry: Selected case studies in Asia (Edited by S. Shen & A. Contreras-Hermosilla). p. 95-128. World Bank Tech. Pap. No. 281. The World Bank. Washington D.C. USA.

Franzel, S., Coe R., Cooper, P., Place, F. and Scherr, S.J. (2001), Assessing the adoption potential of agroforestry practices in sub-Saharan Africa. Agricultural Systems 69 (1-2): 37-62.

Graudal, L. & Kjær, E.D. (2000), Can national tree seed programmes generate economic, social and/or environmental benefits that cover their costs? Danida Forest Seed Centre.

Harwood, C.E. ed. 1992. *Grevillea robusta* in agroforestry and forestry. Proceedings of an international workshop. August 28-31 1990 at ICRAF. International Centre for Research in Agroforestry, Nairobi, Kenya

Holding, C. and Omondi, W. 1998. Evolution of provision of tree seed in extension programmes. Case studies from Kenya and Uganda. RELMA. 41 pp.

ICRAF, 2000. Paths to prosperity through agroforestry. ICRAF´s Corporate Strategy, 2001-2010.

IFSP / DFSC 2000. Establishment of field demonstration plots by the regional tree seed centres in Indonesia. Indonesian Forest Seed Project. Bandung. Indonesia.

Kindt, R 1997. Local perceptions on tree propagation and domestication. AFRENA report 115. International Centre for Research in Agroforestry, Nairobi, Kenya. 38 pp.

Kindt R ., Lilleso J.P.B.,Mbora A.,Miriuki J.,Wabugu C., Frost W ., Biniest J., Aithal A., Awimbo J.,Rao s., Holding –Anyonge C., 2006.*Tree seeds for farmers- A Tool kit and reference source* .World Agriforestry Centre ,Nairobi ,Kenya.

Kjaer, E. D. & Nathan. I. 2000. Three Approaches for Integrating Conservation and Development. Danida Forest Seed Centre.

Nieuwenhuis, M. and O'Connor, N. 2000. Challenges and opportunities for small-scale tree nurseries in the East African highlands. Unasylva 203, Vol. 51. 56-60.

Nathan. I. 2000. Decentralisation, Small Farmers and Sustainability: the Case of the National Tree Seed Programme (NTSP) in Tanzania. Danida Forest Seed Centre.

Nathan, I. 2001. Decentralisation, Small Farmers, and Sustainability. A Case Study of the National Tree Seed Programme (NTSP) in Tanzania. A joint NTSP/DFSC publication.

Simons, T., 1997. The Importance of Germplasm Policies in Tree Domestication. Advance proceedings of the International Workshop on Policy Aspects of Tree Germplasm Demand and Supply organized at ICRAF, Nairobi

Tengnas B 1994 .Agroforestry Extension Manual for Kenya . Nairobi, International Centre for Agroforestry.

Shanks, E. and Carter, J. (1994), 'The organisation of small-scale nurseries', *Rural Development Forestry Study Guide 1*, Rural Development Forestry Network Overseas Development Institute, Stag Place, London, 144 pp.

Spiers, N. and Stewart, M. 1992. Use of *Grevillea robusta* in Embu and Meru Districts of Kenya. In *Grevillea robusta* in Agroforestry and Forestry. International Centre for Research in Agroforestry, Nairobi.

Wambugu C. 2001. *Calliandra calothyrsus*. Nursery establishment and management. A pamphlet for farmers and extension staff. International Centre for Research in Agroforestry, Nairobi, Kenya. 9 pp.

Wightman, K. 1999. Good Tree Nursery Practices: Practical guidelines for community nurseries. International Centre for Research in Agroforestry, Nairobi.