

# Tree Seed Quality Guide



FOREST & LANDSCAPE



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We conduct research in eighteen other countries around the developing world. We receive our funding from over 50 different governments, private foundations, international organizations and regional development banks.

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## **Tree Seed Quality Guide**

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**Layout:** Alexious N. Mutua

**Cover photo:** A farmer's plantation of a 3 year old *Melia volkensii* tree species, seed processing - fresh fruits of same species, extracted seeds and cracked seeds for germination photos by Peter Angaine.

**Back photo:** *Acacia seyal* trees photo by Lovett, germinating seeds of Acacia species in the ILRI lab photo by Anne Mboru and goat browsing fresh leaves of acacia photo by Colin E. Hughes.

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## **Acknowledgements**

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Last but not least all the farmers and extension agents, who contributed to this booklet during the field testing through sharing their experiences in tree seed quality, among them are those farmers and extension agents from areas around Mt. Kenya (James H. Mwangi, Rukaria G. Stanley, Fredrick M. Maingi, Samson Kinyua, Ephantus Muriithi Njagi) and all those others (farmers & extension agents e.g. John Mwangi British among others) from Thika working with Green Zones Development Support Project of Kenya Forest Service and nursery operators working with Mt. Kenya East Pilot project for natural resources management-MKEPP

## **Introduction**

The drive to plant trees is on the increase as the values of trees and forest are being appreciated the world over. The pressure has led to a marked increase in demand for forest seeds and other planting materials in many countries. In most tree species, seeds are critical for production of seedlings. The majority of afforestation and agroforestry programs depend on seed as a planting material.

In Kenya, the need for availability of quality tree planting material to support afforestation involving government, NGOs and farmers has been emphasized in the Forests Act 2005. Many field surveys have indicated that the available tree planting materials are of poor quality in terms of genetic, physical and physiological qualities (Muriuki 2005, Mbora et al. 2007, and Imo et al. 2006). The poor quality germplasm has led to poor performance of most trees and tree populations thus eroding the incentive to plant trees. Afforestation and tree planting is therefore losing out in competition with other land uses. Therefore the provision of adequate high quality seed is critical in promoting agroforestry and tree planting in general. Most farmers are encouraged to plant trees by the high chances of attaining the expected tree related goods and services. The time interval between planting and realization of benefits is usually long in most tree species making it necessary to ensure that quality propagules are used.

Quality factors that must be considered when producing or procuring seeds for agroforestry are genetic, physical and physiological. The farmers and even extension staff need to understand role and importance of these factors in seed quality and the resultant tree population performance. Tree seeds are often regarded as inferior to crop seeds, a misnomer (mistaken belief) that needs to be rectified to promote tree planting. This guide is an attempt to raise awareness on the basic principles on how to produce or access good quality tree seed. Therefore, the authors prepared this guidelines in order to emphasize on the importance of using good quality seed and also to use it as a platform for all seed users e.g. farmers, NGOs and extension agents. The main objective of seed quality awareness rising developed in this guide is to enhance the understanding of different elements of tree seed quality to farmers, and find out measures which can be taken to produce or access the best available material for planting.

## What is seed quality?

Seed quality refers to the value of the seed. Seed of the best quality will result in trees of the best quality in the field. Seed quality can be defined as the inherent attributes of a seed that determine its germination potential and there after its growth characteristics. Seeds of the highest quality will result in trees of the highest value in the field. Seeds of low quality will result in trees of poor quality.

## What affects seed quality?

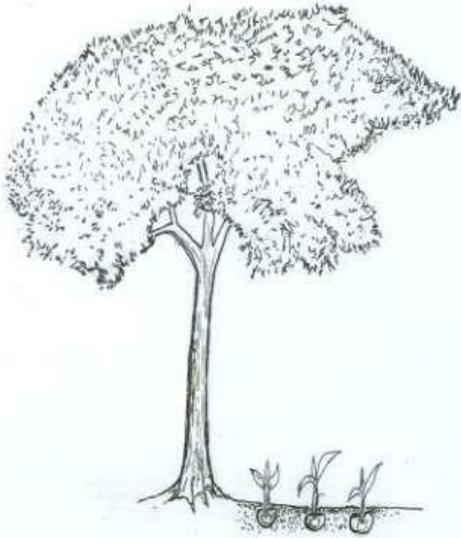
Many factors influence the quality of seed and the quality of the tree that will grow from the seed. These factors can be categorised as:

- **Genetic quality.** The genetic quality is determined by the genetic information contained in the seed. All genetic information of the future plant is contained in the genes of the seed. A tree with poor genetic composition will not grow well in the field. Quality seed is expected to have superior inheritable quality so as to produce the expected products and services. The desirable genetic traits include vigor/fast growth, pest tolerance/resistance and quality products/service. The diversity of inheritable characteristics (genepool) of the seed lot is also a crucial factor for adaptability of the resultant tree population establishment and even growth.
- **Physical quality.** These are characteristics such as size, colour, age, vigour, seed coat condition such as absence of cracks, damages and absence of pests or diseases that may negatively affect germination. Seed with high physical quality is supposed to be whole and sound. It is expected to be of optimal size (as per the species).
- **Physiological quality.** These characteristics directly influence the difference between the number of seeds and the number of trees that will grow from these seeds. These characteristics include seed purity, moisture content, germination percentage and vigour. These characteristics can be measured by seed testing. When you know the physiological quality, you can calculate the number of seeds that you need to obtain the number of trees that you want in the field. Environmental conditions during seed development and maturity level of

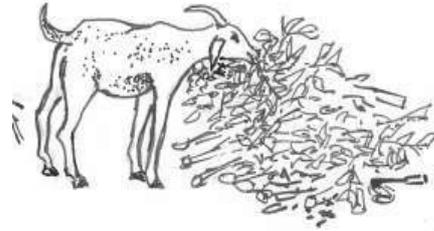
seed determine its physiological quality. Quality seed is expected to have developed mature tissues with optimal biochemical balance.

These seed quality factors should form the guide for producing and procuring seed by extension agents, NGOs, nursery operators and farmers.

## What is seed quality?



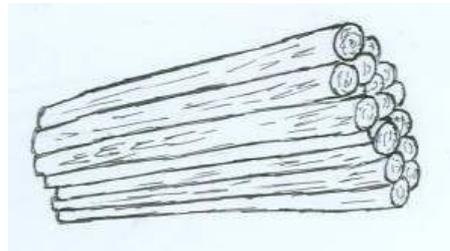
Quality seeds germinate and produce high quality tree



Quality seeds produce trees with high quality fodder



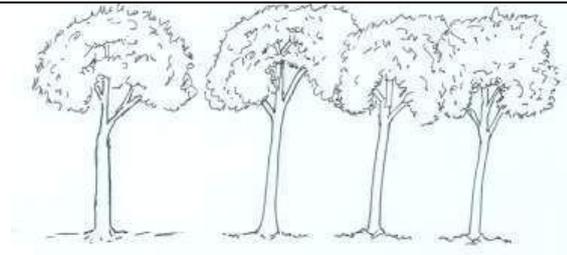
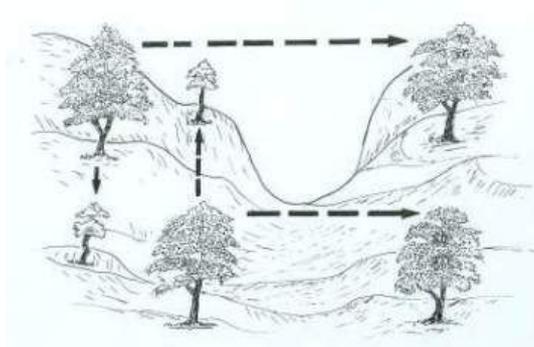
Quality seeds produce trees with tasty and nutritious fruit



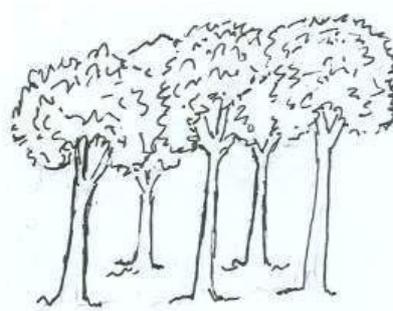
Quality seeds produce trees which give high quality timber

## Components of seed quality

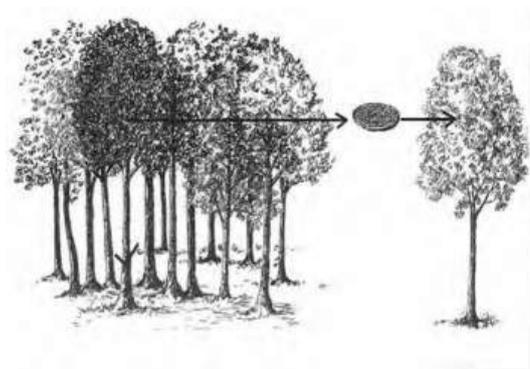
1. Seed expresses its potential in full, if planted in sites with desirable environmental conditions. Success rates are increased if seed is planted in a site with conditions similar to those at the seed source e.g. similar temperature, rainfall, altitude and same soil characteristics.



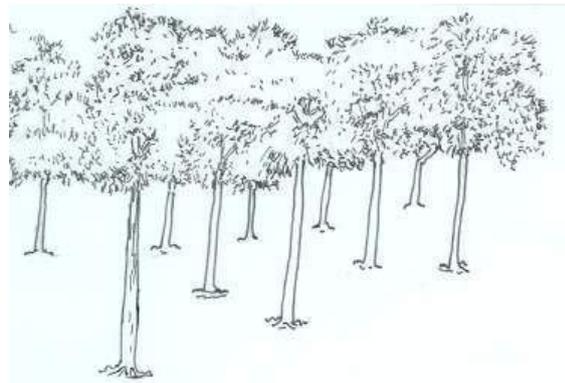
2. Good trees for producing high quality seed: healthy, big crowns, uniform size, uniformity in flowering and seeding, good form, high branches and well spaced.



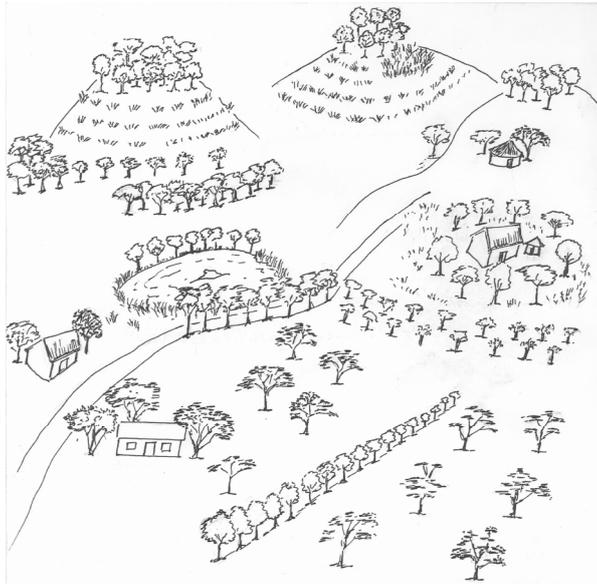
Good genetic mix: Seeds produced by many trees of the same species allowing cross pollination. The tree populations could be in line, a group or scattered.



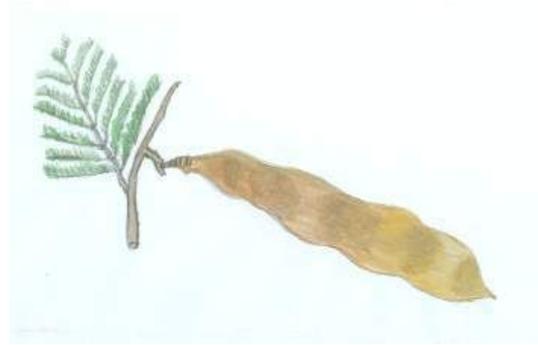
3. Seeds collected from mother trees which are surrounded by other good quality trees.



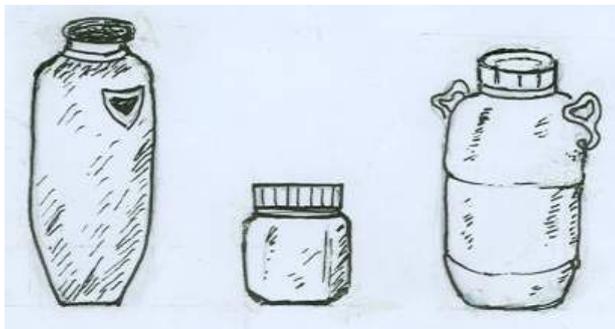
4. Seeds with superior inherited traits for good growth performance, healthy and shape with the desired end products such as timber, fruit fodder.



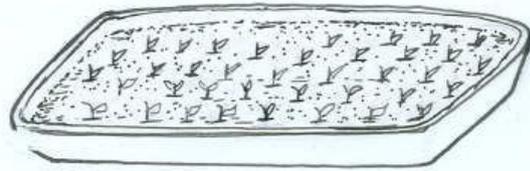
5. Seeds collected from a number of unrelated mother trees (normally >30 trees). Small but equal amounts of seed from each mother tree. Collected from adjacent farms and bulked. The seed should then be shared out again by all farmers who had contributed the seed.



6. Seeds which are harvested when optimally mature. Example above; brown pods of *Calliandra calothyrsus*. Farmers need to know the visible signs of seed maturity for different species.



7. Quality seed can be stored for relatively longer time under good storage conditions e.g. when stored in good containers. However seeds with high moisture content and sensitive to drying (recalcitrant) should be sown immediately after harvest. Some recalcitrant seed may be temporarily stored in moist sawdust at room temperature.



8. Seeds which are harvested when mature germinate well and produce healthy seedlings, which under optimum conditions will grow fast into good trees. The trees should be able to produce desired goods and services e.g. good fodder, tasty fruit, good timber or good paper.

## What is the basic information that should be on the label of any seed?

The basic information should be; species name (botanical or local name), date of collection/processing, testing date, germination percentage, purity percentage, origin or seed source (location/provenance), seed source type, number of trees collected from, weight of the seed and name of the seed collector.



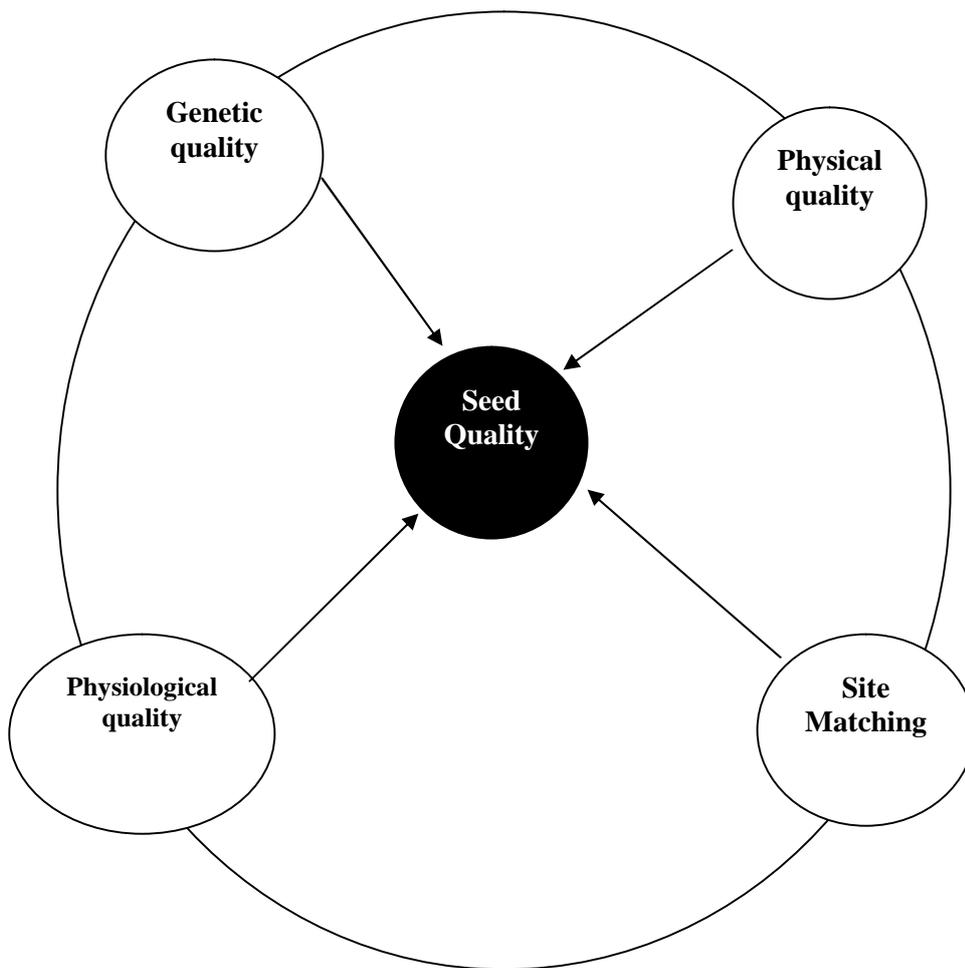
*A sack with pods and a label of seed information inside and outside the bag*

Documentation gives seed an identity, allows traceability and removes the burden of memorizing details during all stages of seed production, handling, distribution and use. It also builds consumer confidence.

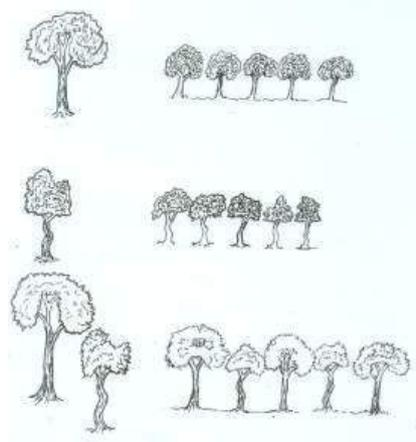
Seeds without documentation may be good or bad but often bad.

**‘Always use documented seed’**

**QUALITY IS A COMBINATION OF:**

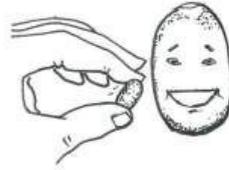


*Genetic quality*



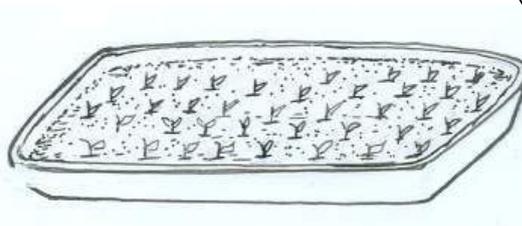
Refers to the trees' genetic information. All the inheritable traits of the future plants are contained in the genes of its seed. A tree with good genetic make-up grows well in the field. Broad genetic mix in a seed lot is often an assurance of good performance of the resultant tree populations.

*Physical quality*



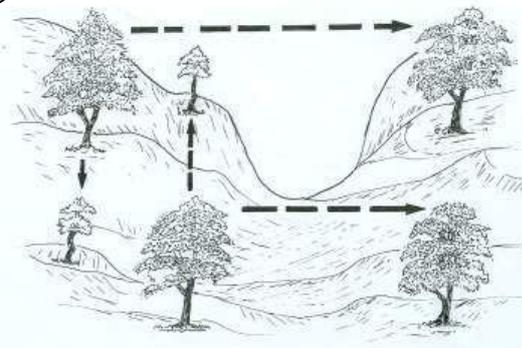
Clean seeds free from pest and good looking refer to seed size, age, weight, color, seed coat conditions and pest or disease damage.

*physiological quality*



Refers to seed maturity, moisture content, integrity of tissues and biochemical processes which influence germination capacity.

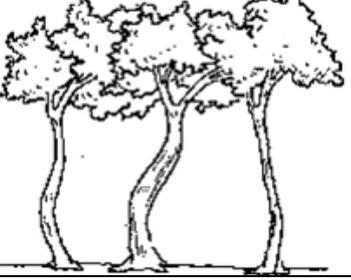
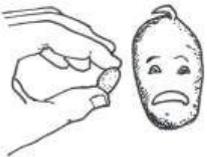
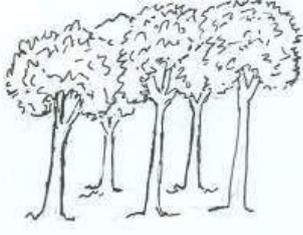
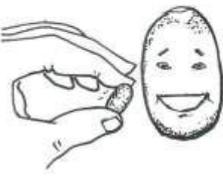
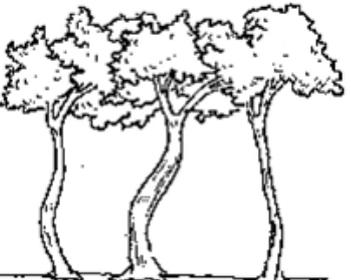
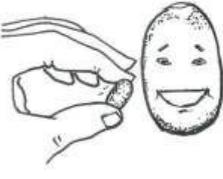
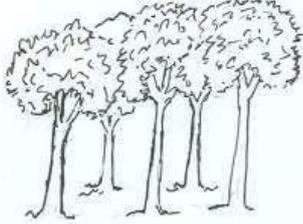
*Site matching*



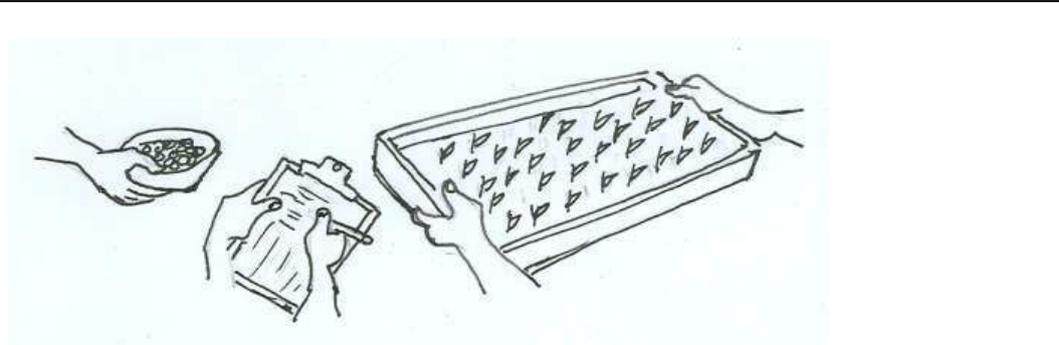
Refers to the optimal growth obtained when site of the seed source and the site where the seed is planted are well matched.

**If any of the four quality parameters is poor, the overall result will be poor**

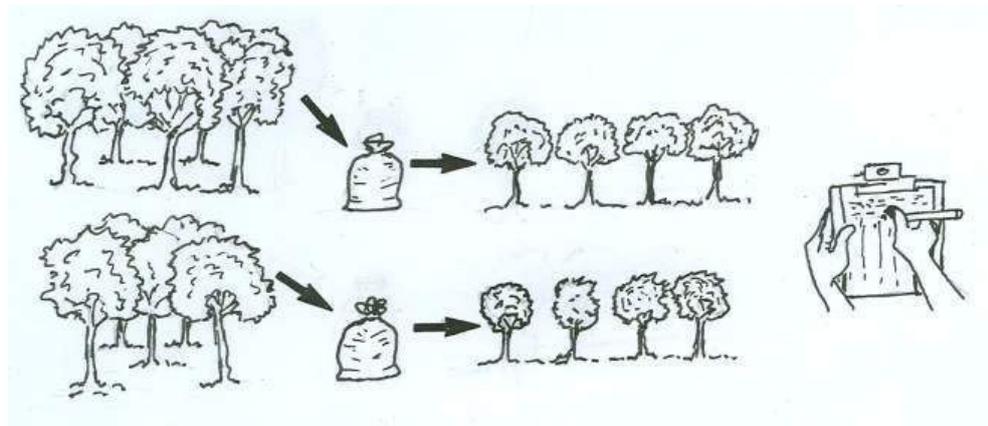
## The best quality is the best combination

Physiological quality	Genetic quality	Example
<p>Poor</p> 	<p>Poor</p> 	<p>Old deteriorated pest infested or immature seed from a poor seed source or few mother trees with poor seeding</p>
<p>Poor</p> 	<p>Good</p> 	<p>Old deteriorated pest infested or immature seed from a good seed source</p>
<p>Good</p> 	<p>Poor</p> 	<p>Healthy and viable seed from a poor seed source (poor genetic traits, few mother trees, poor seeding)</p>
<p>Good</p> 	<p>Good</p> 	<p>Healthy and viable seed collected from a good seed source (&gt;30 trees) that matches the planting site</p>

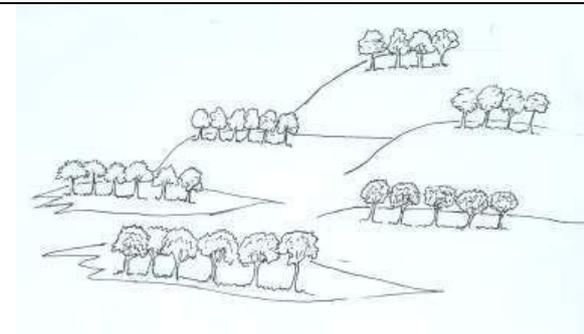
## QUALITY CAN BE TESTED



A physiological test results indicate the viability and purity of seeds including level of pest infestation or disease infection



A genetic quality test indicates gene composition (inherited performance) of the offspring



A site matching test indicates the inherited growth ability of different seed origin (sources) on a particular planting site

## QUALITY IS RELATIVE!

Quality is relative, good quality is the best available, which may be:



Seed orchard seeds with all documentation for superior performance (improved quality seed).



Seeds from a good natural forest seed source or local source with good health and germination capacity.

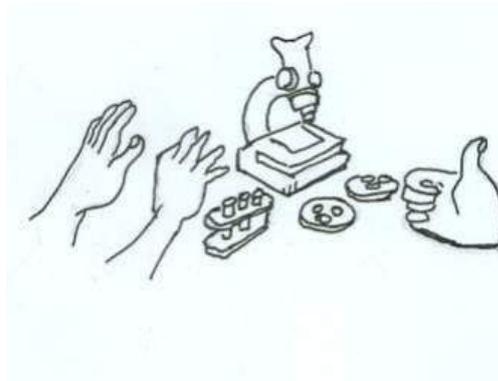
## SOME MISCONCEPTIONS ABOUT SEED QUALITY

 <p><b>Seed orchard seed is always good</b>          Restriction: To yield superior quality seed, seed orchards must be isolated from poor trees or stands and genetically upgraded by genetic thinning after tests.</p>	 <p><b>Advanced bred seed is always better than average seed</b>          Restriction: Seeds produced through advanced plant breeding may not be better, if seeds are planted in unmatched site. The source must primarily match the planting site, a less advanced source may be better if it matches the planting site better.</p>
 <p><b>Documented seed is better seed</b>          Restriction: Documentation doesn't improve the seed. Documentation must prove that the seed is better (but in practice undocumented seed is often poor).</p>	 <p><b>Imported seed is better than local seed</b>          Restriction: Imported seed can be from poor and non-matching seed sources: - quality of imported seed must be documented. It may introduce dangerous pests.</p>



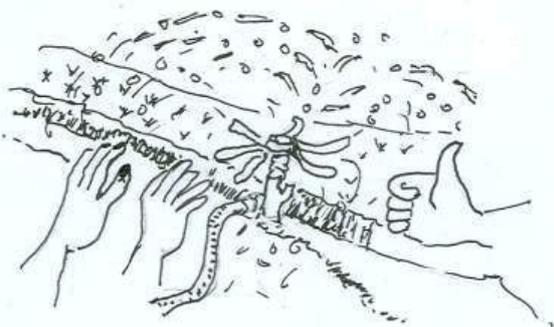
**Local seed is better than imported seed**

Restriction: Local seed can be from a degraded, self pollinated source or from few mother trees, which may undermine the advantage of local adaptation.



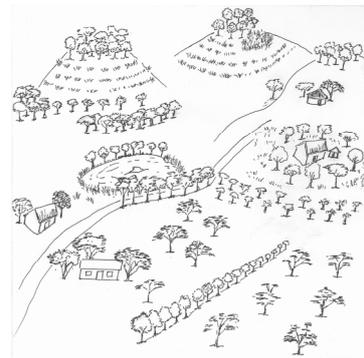
**Plants from tissue culture (TC) are better than plants from seed**

Restriction: Tissue culture is a vegetative propagation method not an improvement method. TC plants can never be better than the mother trees, only TC plants derived from highly improved and tested material are high quality.



**Seed and seedlings produced by high technology is the best**

Restriction: Technology of seed procurement and nursery does not improve the genetic quality.



Good quality seeds collected from single tree growing in the compound near home are always good as long as seeds are collected from the ground after they drop from the tree.

Restriction: Seeds collected from the ground are often infested by insects, fungi or bacteria. Trees growing around homesteads may also be isolated from other trees. Seeds collected from one single tree are not good

## Misconceptions on pollination raised by Thika Seed Farmers and extension agents during the field testing of the draft of seed quality book

1. Trees such as *Cordia africana* contaminate maize during pollination which changes maize colour to yellow.

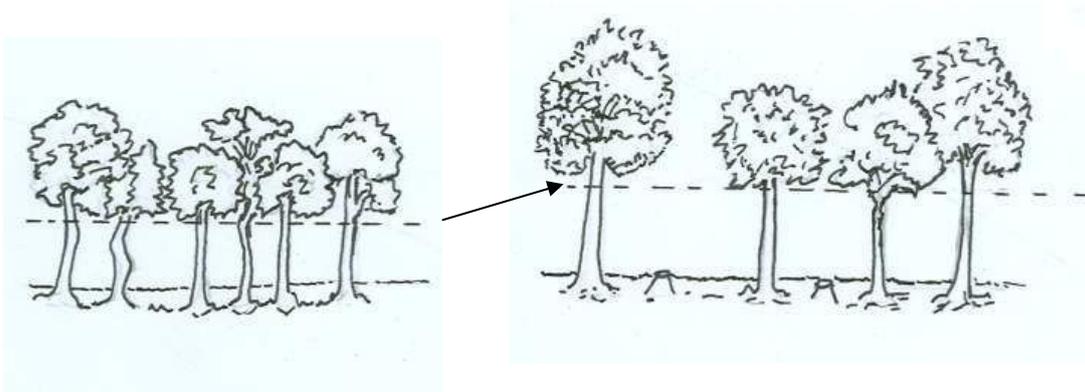
Restriction: Plants of different plant species cannot cross-pollinate thus not possible to have *Cordia africana* tree cross-pollinate with maize plants.

2. Cross pollination can occur even when the species are different.

Restriction: Cross pollination cannot occur within different tree species.

## Quality seed costs, but it pays

## How can you improve genetic seed quality?



**REMEMBER: Average - poor = better**

**Note:** Seed sources can also get worse if good trees are cut and poor trees left behind for seed production. The deterioration may even be aggravated if the remaining trees are left widely spaced limiting pollination.

## **WHY SHOULD I USE GOOD QUALITY SEEDS OR PLANTING MATERIALS?**

### **1. A Good quality seed gives high quality end products or services**

For example, for timber trees, the value of the wood is connected to quality criteria such as straightness, branching habits, wood density and the number of knots in sawn timber.

### **2. Use of high quality seed minimizes cost of production by ensuring high rate of survival, fast growth, low infection by diseases and pests**

Trees raised from high quality seed grow uniformly, faster and normally with little or no infection. This makes the cost of production of any end products low compared to trees raised from poor seed.

### **3. Plantations raised from good quality seed can make good seed sources**

For example, good plantations can often be used as a seed sources. The better the genetic quality of the plantation, the higher is the genetic quality of the seeds collected from them.

### **4. Use of good quality seed allows the best use of available land**

For example, a good tree takes up the same space as a poor one. Where land resources are limited e.g. in intensive farming areas in Kenya, individual farm plots are small and the productivity of each unit of land is important.

### **5. Trees unlike crops take long time to mature; thus investment in raising high quality plant material is worthwhile**

For example, any mistake made during a tree species establishment may take time to correct since one may notice the mistake after many years. An example is Cypress trees planted in East Africa, where the plant material used to establish was from 12 trees from South Africa. The aphid attack to this species has raised the alarm of narrow genetic base of parent material

### **6. A good quality tree gives economic return faster than a poor quality one**

Forestry is long-term investment and the time required from sowing to harvesting is often long, so improved growth rate gives faster return, and for relatively slow growing species, shorten the rotation to an acceptable level.

**7. Maintenance of good quality plantations is often lower, as the trees grows faster and are more competitive**

The highest labour cost in plantation establishment is maintenance and weeding. The faster the establishment, the quicker the crowns will close and shade out the weed and the shorter the necessity of weeding.

**8. Use of quality material encourages improvement and development of even better material in future**

Quality improvement is a process linked with planting. The higher the demand or appreciation of improved material, the higher the improvement effort.

## **WHY ARE POOR QUALITY SEEDS SOMETIMES USED IN TREE PLANTING BY FARMERS AND FORESTERS?**

Some poor reasons for not using high quality seeds or planting material:

### **1. Good quality seed is not available**

For a number of exotic tree species e.g. Pines, Cypress, *Grevillea robusta*, *Calliandra calothyrsus*, *Casuarina equisetifolia*, *Eucalyptus grandis* and *Eucalyptus camaldulensis*, planting materials from good seed sources are available from authorized suppliers such as national research institutions such as Kenya Forestry Research Institute (KEFRI) or from international institutions like ICRAF (which only supplies to national partners and their scientist). These suppliers can provide seed from the best available seed sources, which are often better than randomly collected or undocumented seed.

### **2. Good quality seed is too expensive**

Often wrong - The extra cost of using good seed is often already gained in the nursery by better growth of seedlings. Compared to the ultimate value of the trees, the cost of seeds and seedlings is usually very small.

### **3. Good quality seed is only sold in large quantities**

Often wrong - Some suppliers allow farmers to buy seeds packed in small quantities e.g. 100 g at a cost that they can afford.

### **4. Fast growing trees produce poor quality wood**

Often wrong - Many fast growing trees produce good wood and often more uniform than slow growing trees.

### **5. There is no truth in labeling; you can never be sure you really have got a better quality.**

Often wrong - For a number of tree species, certified seed can be obtained, where the quality is documented or declared by a certifying institution.

### **6. Seed quality is irrelevant for planting trees to offer services like shade, shelter, reclamation, soil improvement and water catchment**

Often wrong - For all planting purposes, seed must be of high genetic and physiological quality. Even those planted mainly to provide services, can also be used as wood resources or to provide fruits in future. Production and environmental planting is often integrated.

## WHERE CAN ONE GET GOOD QUALITY PLANTING MATERIAL OR SEED?

Quality seeds can be bought or obtained from authorized seed suppliers such as National Research institutions, for example KEFRI (contact- 0722157414/ Wireless: +254-20-2010651/2; email: [kefri@nbi.ispkenya.com](mailto:kefri@nbi.ispkenya.com)) or other organizations producing or procuring tree seed for distribution, such as;

No	Name of Organization	Contacts
1.	Vi-Agroforestry Project	+254-57 2020386 Email: <a href="mailto:kisumu@viafp.org">kisumu@viafp.org</a>
2.	Laikipia Tree seeds and Seedling Dealers Association (LETSSDA)	Michael Mugo/Timu Tel +254 721824333 / 0721996266 / 0734452131
3	Kenya Tree Seed and Nursery Operators (KATRENDO)	John Mwangi British (Secretary) +254 734632476 Edward Mutitu (Chairman) +254 721809095 Beatrice Wanjiku Kiragu (Treasurer) +254 736447017 / 722250691 Gil Kamau +254 735744232
4	Green Zone Development Project	Mwanzia +254 2511222 / 2511299 <a href="mailto:jmwanzia@kenyaforestservice.org">jmwanzia@kenyaforestservice.org</a>
5	Mt. Kenya East Pilot project for natural resources management - MKEPP	+254 068-31376 Email: <a href="mailto:pmu@mkepp.or.ke">pmu@mkepp.or.ke</a>
6	ICRAF - World Agroforestry Centre	+254 20 7224000 (provides only high quality plant material which is not available locally to National partners and ICRAF scientists)

Information on how to procure seed can be obtained by getting in contact with National Seed Centre or by reading resources like ICRAF's **Tree Seeds for Farmers Toolkit** or the **Tree Seed Suppliers Directory**. These resources provide information on the different suppliers of tree planting material (see references at the end of this guide).

## Further reading

Kindt R., Lillesø, J-P. B. Mbora A., Muriuki J., Wambugu C., Frost W., Beniest J., Aithal A., Awimbo J., Rao S., Holding-Anyonge C., 2006. Tree seeds for farmers: A toolkit and reference source. Nairobi. World Agroforestry Centre. ISBN: 929059182X

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Mbora, A. and Lillesø, J-P.B. 2007. Sources of tree seed and vegetative propagation of trees around Mt. Kenya. Development and Environment. No. 9-2007. Forest & Landscape Denmark

Muriuki, J.K. 2005. Informal agroforestry tree seed quality and supply systems: A case of peri-urban Nairobi, Meru and Western Kenya. Environmental Sciences. M.Env.S. (ARD). Kenyatta University, Kenya. N50/9017/00

Imo', M., Ogweno, D. O., Ochieng, E.A., Gachanja, M. and Kanyanya, E. 2006. Recent trends in national tree seedling production in Kenya. In: Proceedings of the first KFS scientific conference 2005. Kenya Forest Society. Kenya. Pgs 20-28. ISBN 9966-955-48-8

Kindt R., Mutua A., Muasya S. and Kimotho J. 2002 Tree Seed Suppliers Directory: Sources of seed and microsybionts.

<http://www.worldagroforestry./reorgsources/databases/agroforestree>



