

## Integrating high-value multipurpose trees with soil and water conservation to improve livelihoods and reduce land degradation in Ethiopia

Diagnostic activities conducted at the Africa RISING research sites in 2013 identified interest among farmers to produce high-value crops such as fruit trees. Fruit trees (avocado, olive, apple) are an untapped opportunity for smallholder farmers in the highlands of Ethiopia.

The Africa RISING research protocol on high-value crops is a collaborative effort by ICRAF, ILRI and IWMI to select superior fruit tree cultivars with high yielding varieties and determine and alleviate the constraints to their wider adoption.

Under the protocol, six high yielding varieties of avocado which can grow well in southern and south-western parts of Ethiopia have been introduced at the Lemo site. These varieties yield fruits after just two to three years. The cultivars are propagated through grafting from superior seedlings. The research team is also raising awareness of the potential of apple trees in three regions of Ethiopia (Amhara, Oromia and Tigray).

Prior to seedling distribution, farmers' training on pre-and post-planting tree management was organized at the fruit tree nursery of the Ministry of Agriculture (MOA) in Butajira in May 2013 and in Debre Birhan in June 2013. Eighty farmers participated from two kebeles.

For training on apple trees, 50 farmers and development agents from the three woredas went to Debre Birhan to gain theoretical and practical training on pre- and after-planting management that will:

- Increase farmers understanding of fruit trees in achieving household food security and nutrition;
- Provide important information on environmental and resources requirements of planted fruit cultivars;
- Equip farmers with planting and early care of fruit trees;
- After-planting management of grafted seedlings.

Policy initiatives to enhance tree farming in different landscapes and farming systems include the Forest Policy (MoARD 2007), the Growth and Transformation Plan (FDRE 2010), the Sustainable Land Management 15 years program framework (MoARD 2008), a reforestation program for 15 million hectares of land, a program to establish 100 million *Faidherbia albida* trees on cereal cropland, land registration and certification proclamations, and the Climate Resilient Green Economy (CRGE) strategy.



Figure 1 Field demonstration on how to plant and untie the plastic tie from the grafted point

### On farm research

About five hundred improved avocado seedlings were planted on farmers' fields. The project provided six seedlings to each participant. The planted seedlings were fenced and tagged. Survival and growth performance of the planted seedlings is being monitored at three-month intervals. A mixed blessing perhaps, but one female farmer reported that two of her planted seedlings were stolen from her backyard indicating a high local demand.

Similarly, highland temperate fruit planting was carried out at three sites: In total, 1500 improved apple tree seedlings were planted. Before distributing the seedlings, farmers were familiarized with appropriate management practices and survival and growth performance is being monitored every three months.

### Research themes

In addition to on farm trials, the project has established experimental plots at the farm of a private investor in Debre Birhan and greenhouse plots at the Holeta research centre.

These are being used to study the following research topics in greater depth.

Detailed research topics	Type of the research	Site
Site suitability study (soil characterization, soil fertility, niche preference, temperature (chilling unit) and climate matching) for different apple varieties	Field observation, field measurements, greenhouse and laboratory based	Sinana, Hosana, Debre Birhan, and Tigray and Holeta research centres
Site suitability study (soil characterization, soil fertility, niche preference, and physical requirements) for improved avocado varieties	Field observation, field measurements, and laboratory	Hosana
Dormancy breaking through leaf defoliation and timing for apple trees	Field observation and measurements	Debre Birhan / Ato Abyi farm
Growth and yield performance of different avocado/apple varieties	Field observation and measurement	Sinana, Hosana, Debre Birhan, and Tigray (FTC/Debre Birhan University farm)
Stomatal conductance and response to environmental stress and management variables of apple	Field observation and measurement, laboratory	Debre Birhan / Ato Abyi farm
Pruning and pinching requirement of apple trees	Field observation and measurement	Debre Birhan / Ato Abyi farm and on farm
Inflorescences removal of premature avocado trees and subsequent yield increment	Field observation and measurement	Butajira fruit trees nursery site and on farm research
Soil fertility and apple fruit quality: implication for satisfying household nutrition requirement and market requirement	Field observation and measurement, laboratory	Debre Birhan / Ato Abyi farm and Addis Ababa University nutrition laboratory
Molecular studies on drought stress ability of different apple varieties	Laboratory	Addis Ababa university/ Nairobi-ICRAF laboratory
Propagation (grafting and budding) to improve lateral and leading shoots and yield of apple tree on different rootstocks	Field observation and measurements	Debre Birhan-Ato Abyi farm/ Debre Birhan University farm
Baseline survey	Socio-economic study	Sinana, Hosana, Debre Birhan and Tigray
Smallholder adoption of improved avocado and apple varieties	Socio-economic study	Sinana, Hosana, Debre Birhan and Tigray

## Capacity building

### Ongoing PhD work by Abaynhe Melke

- Eco-physiology of winter chilling temperature requirements for apples grown in some Ethiopian highlands: Comparison of chill unit models validation
- Use of artificial dormancy breaking treatments to compensate incomplete chilling in apples for better flowering and fruit setting under tropical highland conditions
- Evaluation of rootstock-scion compatibility of apple cultivars grafted on M-7 semi-dwarf rootstock: Comparison of budding and grafting techniques
- Highland environments will be clustered based on their chilling hour that helps for introduction of appropriate apple cultivars and to scale up the results to other sites
- Improve on-time flowering and fruiting.
- Best propagation method for apple cultivars identified

### Preliminary apple yield survey from private apple farm (3-5 years old trees)

Yield performances of 4 apple varieties were assessed at the private Abyi fruit farm. The low-chill cultivars (Anna and Princesa) showed better yield than medium chilling type cultivars (Gala and Permicia). The average yield harvested from Anna cultivate was 10 kg tree - followed by Princesa (8.5 kg), Gala (6 kg) and Permicia (5 – 6 kg). Better fruit colour, size, and weight (90 g) were found for Anna. This indicated that low-chill cultivars grow well in most highlands of Ethiopia.

### Suggestions for further research

- Root-stock scion compatibility study requires further investigation for more confirmation on the influence of rootstocks on apple tree yield;
- Growth synchronization and pollination problems are observed. Thorough study is needed on growth synchronization and pollination ecology of apples to increase fruit yield and quality and an optimal nutrient requirement study on temperate fruits is crucial.



The Africa Research In Sustainable Intensification for the Next Generation (Africa RISING) program comprises three research-for-development projects supported by the United States Agency for International Development as part of the U.S. government's Feed the Future initiative.

Through action research and development partnerships, Africa RISING will create opportunities for smallholder farm households to move out of hunger and poverty through sustainably intensified farming systems that improve food, nutrition, and income security, particularly for women and children, and conserve or enhance the natural resource base.

The three projects are led by the International Institute of Tropical Agriculture (in West Africa and East and Southern Africa) and the International Livestock Research Institute (in the Ethiopian Highlands). The International Food Policy Research Institute leads an associated project on monitoring, evaluation and impact assessment.

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