Ministry of Agriculture, Irrigation and Livestock
Department of Horticulture

THE FRUIT TREE NURSERY INDUSTRY OF AFGHANISTAN

TRAINING SERIES 1

THE MOTHER STOCK NURSERY

2

MANUAL

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Training Series 1: The Mother Stock Nursery

Volumes in this Series:

- Manual 1 The fruit tree nursery growers' association
- Manual 2 The mother stock nursery
- Manual 3 The fruit tree production nursery

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Introduction

The purpose of Manual 2 is to provide a guide for the correct use of mother trees for producing high quality fruit tree propagation materials: scion materials (graftwood and budwood), cuttings, and seeds for rootstocks. At the same time, this manual intends to move towards the development of standard procedures for the production of certified planting materials.

In Manual 1 of this Series you find information related to the nursery industry organization. We describe the steps to create horticulture associations, and in particular, nursery growers associations. We also highlight the necessity of having some of the participating nurseries specialized in the production of mother stock trees, to produce certified propagation materials.

Manual 2 provides information useful to understand (a) what is a mother stock nursery, (b) which nurseries could become good mother stock nurseries, (c) how you can train extension personnel and mother stock nursery growers about how to establish and manage a mother stock nursery, and (d) what are the main steps to establish the production of traceable and certified planting materials. The manual is limited to the most important fruit tree species for commercial production in Afghanistan. This manual aims to provide technical information, but using simple, practical language for those who are not highly specialized in the perennial horticulture sciences.

This manual has been designed for extension personnel to train nursery growers. However, it is also suitable for a wide range of users as a reference manual, including university students, teachers, and development organizations working in the perennial horticulture sector. Simple, practical language is used to reach the broadest audience possible.

Content of the manual

The manual is divided into three parts:

- Part 1 provides technical information and basic principles of fruit tree planting materials, mother stock nurseries, and the production and conservation of virus free nuclear materials.
- Part 2 presents a guide for the facilitation of the process of planning and establishing a mother stock nursery, with recommendations oriented towards a certification scheme.
- Part 3 provides practical guidelines to train nursery growers and implement the mother stock nursery system, using improved horticultural techniques available in Afghanistan. This is the "*Field training*" section.

Part 1

Development of an improved nursery industry in Afghanistan

After reading Part 1, you will:

- Understand the importance of high value fruit tree planting materials and their conservation in the Afghanistan National Collection of Fruits and Nuts
- Learn how these valuable genetic resources can be maintained in a healthy state and protected from infectious pathogens
- Be able to guide nursery growers in the running of mother stock nurseries, and to prepare training sessions for extensionists and growers

1. Improved nursery industry

1.1. Mother stock propagation materials

Commercial fruit tree nurseries have the important function of multiplying and distributing improved fruit trees to orchard growers.

A mother stock nursery is a commercial nursery that is specialised in the production of true-to-type and healthy propagation materials for distribution to other commercial nurseries. True-to-type propagation materials refer to materials coming from a tree whose identity is known. These propagation materials include scion material for grafting and budding, cuttings, and rootstocks. The plants of the mother stock nursery used to produce propagation materials are therefore called "mother plants".

Figure 1: *Certified budsticks showing certification label (E. Vernon)*

This division of labour within the horticulture industry facilitates raising the quality and value of fruit production for the whole country, and is a key element in positioning perennial horticulture within a demand and export led economic sector.

Plants can be propagated in two ways, sexually and asexually. Reproduction through seed is sexual, except in cases of apomixis. Asexual or vegetative reproduction is the formation of new plants from a single parent plant. These new plants, called clones, are an extension of

Apomixis is a form of asexual reproduction. It occurs in species that produce seeds whose embryos arise from unfertilized eggs. By apomixis, a plant can produce seeds genetically identical to the parent plant.

the parent plant and, therefore, will have the same genetic characteristics. The greatest advantage for horticulturists is to be able to reproduce a variety in which all the resulting plants will have consistent characteristics.

Scion material for grafting and budding

Grafting is an asexual or vegetative method of plant propagation. Grafting consists of connecting two pieces of living plant tissues together in such a way that they unite and grow as one plant. The tissues are called:

- *The scion:* a short piece of the shoot including at least one dormant vegetative bud. The scion will become the aerial part of the plant. When the scion includes only one bud, it is called budding. This practice is commonly used for fruit production.
- *The rootstock:* the lower portion of the graft that develops into the root system.

These methods transfer certain characteristics of the rootstock to the sapling, e.g. hardiness, vigour, drought tolerance, adaptation to certain soil conditions and/or pest and disease resistance.

Grafting and budding require extensive knowledge of nursery crop species and their compatibility; therefore, these two techniques should be undertaken only by the most experienced nursery operators.

Cuttings

Cuttings are portions of plants (stems, leaves, or roots) that can be developed into new intact plants (vegetative propagation), genetically identical to the mother or donor plant. A good cutting consists of healthy plant tissue with some intact buds or leaves. It must also have sufficient stored nutrient reserves to sustain it until new roots are formed, and the plant starts the uptake of minerals and water from the soil. Examples of fruit trees propagated by cuttings include grape, pomegranate, and fig. Many clonal fruit rootstocks are also propagated by cuttings.

Dormant hardwood cuttings are the easiest type of stem cuttings to grow. These cuttings are collected during the dormant season, late autumn through late winter, after trees drop their leaves and when stems are firm.

Softwood cuttings are taken when the stem is still soft in spring or early summer, and generally consist of the terminal portion of the shoot. Softwood cuttings require the use of rooting hormones under a controlled environment, high humidity (mist systems) and constant temperature levels.

Rootstocks

Rootstocks are the part of the grafted or budded tree that will become the root system of the plant. Rootstocks can be produced from seeds or from other parts of the plants. The rootstocks produced by vegetative techniques are called “clonal rootstocks”. Clonal rootstocks have identical characteristics to the mother plant.

Figure 2: *Labelled rootstocks (J.I.Trives)*

A large number of rootstocks for many temperate and subtropical fruit and nut species are raised by

seeds. These species include peach, nectarine, apricot, and citrus. However, for some species (e.g. apple), clonal rootstocks are available that perform much better than seedling rootstocks.

A more detailed explanation of these propagation techniques is presented in **Manual 3 The fruit tree production nursery** of **Series 1** ***The fruit tree nursery industry of Afghanistan***.

1.2. The mother stock nursery

The modernization and improvement of fruit production in Afghanistan requires that registered mother stock nurseries supply other nurseries with certified propagation materials. Nurseries will then supply fruit growers with high value planting materials. We understand high *value planting materials as standardised, certified, and virus free saplings of improved varieties.*

High value saplings allow fruit growers to improve their productivity and the quality of the fruits they produce. Additionally, it also allows them to sell at higher prices and to expand market opportunities, especially by gaining access to high value markets, such as the export market. Thus, farmers can increase their returns and continue investing in improving their production with higher quality saplings.
Consequently, the nursery growers will be able to increase their own incomes, and become an important part of the fruit production value chain by contributing to the improvement of the entire industry.

1.3. Development of a certification scheme for planting materials

The improvement of the fruit tree nursery industry as described, requires the development of a scheme for certification of planting materials. The certification procedures apply throughout the production process up to the point of sale, where the trees are sold with individual certification labels (Figure 3).

In Afghanistan, this scheme is being built on the basis of voluntary agreement. The proposed scheme includes the use of traceability documents to record the location and movement of certified plant materials tracing back to the national collections.

At some point in time, the government is expected to put a legally enforceable regulatory system in place. This regulatory system will rely on regulatory institutions, such as:

- *Plant Certification Authority*
- *Nursery Registration and Inspection*
- *Phytosanitary Control Authority*

Also the regulatory system will be supported by non-regulatory institutions:

- *Variety recommendation panel: current PHDP, Afghanistan National Horticulture Development Organization (ANHDO), universities, etc.*
- *Afghanistan National Nursery Growers Organization (ANNGO)*

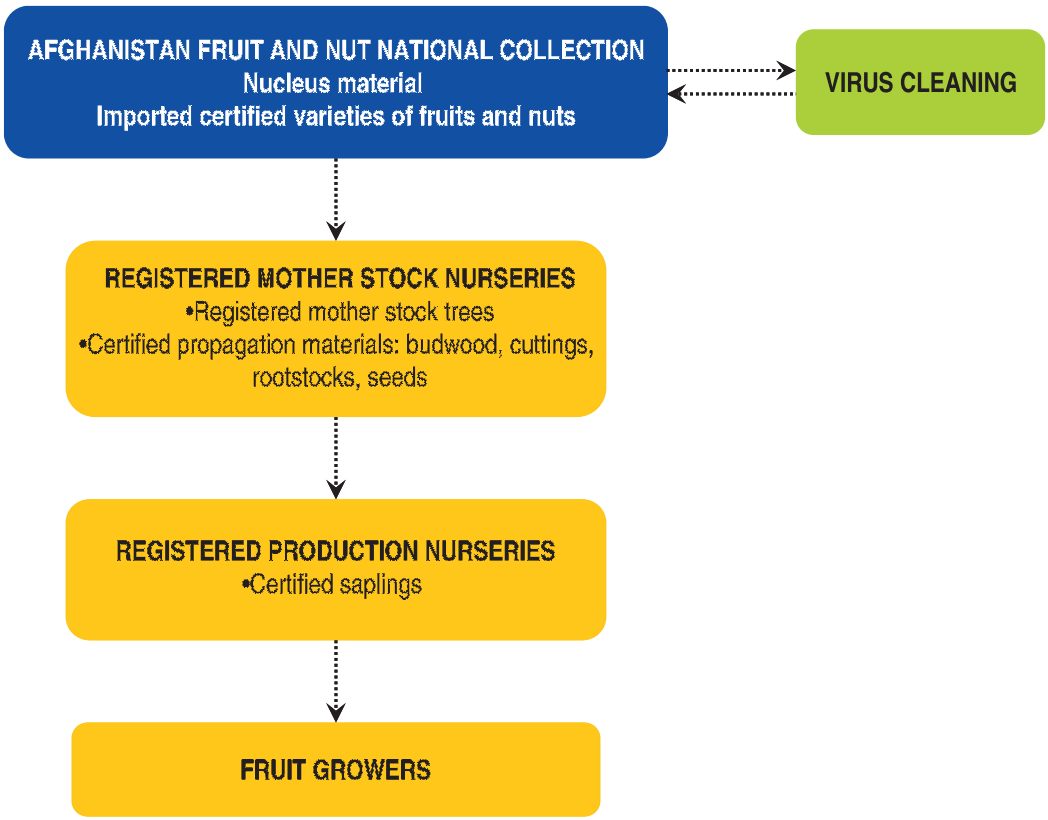


Figure 3: *Plant material certification scheme*

It is anticipated that PHDP 2 will set up virus testing programmes for releasing of virus free materials from the Nucleus Nursery.

2. The Afghanistan National Collection of Fruits and Nuts

Traditionally, nursery growers in Afghanistan have produced propagation materials using buds from commercial fruit orchards or from saplings established the previous year. This practice is problematic. The main problems are:

- *Varietal errors*: Nursery growers cannot be sure which varieties they are propagating
- *Pathogen risk:* It increases the risk of introducing and dispersing plant diseases

In view of this situation, the Ministry of Agriculture, Irrigation and Livestock of Afghanistan (MAIL), through the "Perennial Horticulture Development Project" (PHDP) funded by the European Union, started a comprehensive programme in 2006 to survey and collect germplasm of fruit and nut tree species in Afghanistan. This collection aims to preserve the use of the most important local genotypes. At the same time, the project aims at reducing the risk of genetic erosion by establishing *"in-situ" collections* and open field *"ex-situ" collections* (see Table 1). The collection comprises varieties of the principal fruit and nut tree species: stone fruits, pome fruits, citrus, pomegranate, and a few Mediterranean and subtropical species (see Annex 1 for a list of the species surveyed by this project).

Once the varieties have been collected, characterised and evaluated, they represent a foundational resource for other activities such as demonstration orchards, breeding, eco-geographical studies, etc.

Table 1*: The Afghanistan National Collection of Fruits and Nuts*

THE AFGHANISTAN NATIONAL COLLECTION OF FRUITS AND NUTS	
In situ collection	**Ex situ collection**
The in-situ collection consists of maintaining the fruit trees in the original location, being managed in the farmer's traditional way. In its entirety, the *in-situ* collection fully represents the pool of the local native cultivars relevant for Afghanistan perennial horticulture, and of the varieties introduced from abroad in the past. Both show a wide range of phenotypic variability (those characteristics defined by the interaction of the genotype and environmental conditions of the species) in relevant horticultural traits. This variability is very important for the conservation and use of plant genetic resources. The criteria used to select the varieties were: 1. *Traditionally recognized value of known genotypes* 2. *Adaptability to different locations* 3. *Suitability for local and international markets* 4. *Special genotypes showing outstanding traits (frost/drought resistance, etc.)* 5. *Historical background*	*An ex-situ collection is an orchard serving two purposes: (1) germplasm preservation and (2) supply of propagation material.* For each species of the Afghan National Collection, two *ex-situ* collections were created in different locations. These locations are the main areas of production of the crop in the country. One *ex-situ* collection is kept in a location with the best environmental conditions for the species or group of species in question; the other is maintained as a duplicate collection for safety reasons. Once the varieties are collected and catalogued, the value of the varieties is assessed, and the best varieties are selected for distribution to the fruit tree nursery growers. In 2009, the Afghan National Nursery Growers Organization (ANNGO) received material from the National Collection to establish mother stock nurseries. These mother stock trees will be replaced by virus-free plants in the future.

3. Production of virus free planting materials

3.1. The Virus Indexing Laboratory

Perennial horticulture is very important for the agricultural economy of Afghanistan and for the livelihoods of thousands of farmers. Afghanistan is developing this industry in order to regain its formerly strong position in international markets. An important goal of perennial horticulture development is the establishment of sources of propagation material that are free from transmissible pathogens. In order to support efforts to reach this goal, the health status of the National Collection of Fruit and Nuts in Afghanistan will be systematically evaluated. At the same time, the infrastructure required to produce and disseminate pathogen-free, high quality propagation material to the whole industry, is being built.

Evaluation of the pathogen status of fruit trees begins with visual examination. However, this method is not fully reliable, especially for many viruses, and virus-like pathogens. In order to address the particularly dangerous problem of plant viruses, the Virus Indexing Laboratory was opened in Badam Bagh Experimental Station, in Kabul, in October 2008 to support a programme for indexing and cleaning of propagation materials. This laboratory allows the testing of propagation materials with internationally recognized scientific methods so that only material found free from infection (in particular free from virus and virus-like pathogens) may be released to the industry.

3.2. What is a virus?

Viruses are pathogens that have a very narrow host range. Viruses are units consisting of nucleic acids and coat proteins. Viruses have no energy metabolism of their own. Consequently, they cannot perform synthesis and are thus unable to replicate outside the host plant. Plant viruses are grouped in a number of "varieties". The name of a virus is usually derived from the name of its main host plant.

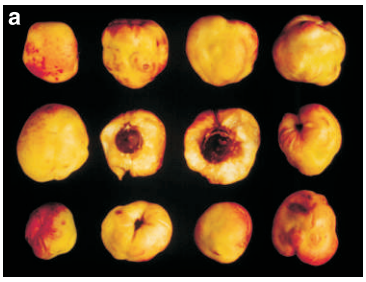
Plant viruses have no specific mechanism of entering the host cell. A cell wall is a difficult obstacle for them. Therefore, plant viruses enter their hosts through injuries or on transmission via invertebrates (i.e. nematodes, insects, etc.). In many cases plants express hypersensitivity as an effective protection strategy. Hypersensitivity expresses itself in the dying of cells in the immediate surroundings of the primary site of infection, thus stopping the spreading of the virus. The symptoms caused at the primary site of infection are called the *primary symptoms*. Symptoms caused by spreading throughout the rest of the plant are called *secondary symptoms*.

Figure 4: *Plant virus symptoms in leaves. Leafroll in grape (a) (Giunchedi L., 2003); Apple mosaic virus in peach leaf (b)(FAO/IPGRI 1996)*

Plant viruses can have severe impact in commercial horticulture:

- Reduction of plant growth
- Graft incompatibility
- Yield reduction
- Deformation or malformation of fruits
- Reduced market quality of fruits

The symptoms of most viruses are dependent on both virus and host, and this is an important diagnostic feature. Virus infections can usually be recognized by mosaic-like leaf patterns of light and dark green. The infection spreads often over the whole leaf beginning at the leaf veins. Leaves that had been infected during their development are usually deformed or rolled. Frequently, lightening of leaf areas, called chlorosis, develops around the primary site of infection. Withering areas are called necrosis.



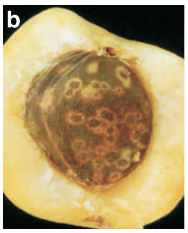


Figure 5: *Plant virus symptoms in fruit. Sharka virus (PPV) in peach (a) and apricot (b) (FAO/IPGRI 1996)*

Virus multiplication

Plant viruses can multiply only within living cells. Some of them multiply within the bodies of aphids and nematodes and some viruses multiply within the plant without causing symptoms. This latter phenomenon is called latent infection.

Virus transmission

Plant viruses vary in their mode of transmission. Aphids or other sap-suckers are the most common mode of transmission. Nematodes living in the soil transmit some viruses.

Sap transmission is important for only a few viruses, and can occur with pruning. Pollen transmission from male flower to female flower occurs for very few viruses. Such viruses are seed-borne. However, most viruses do not get into the gametes and therefore are not seed-borne. In other words, it is improbable that virus diseases appear in new seedlings.

Virus detection

The most common methods for detecting plant viruses include:

- *Visual testing or indexing.* Observation on candidate material, which should be carried out during the best phenological stages in order to recognize symptoms. Indexing is carried out on an individual plant basis.
- *Use of antibodies to the virus.* The most common serological test used is the ELISA test assay (Enzyme Linked Immunosorbent Assay). In the ELISA test plant sap is placed in a plastic tray which contains wells; proteins, including the virus, are adsorbed onto the well. This is a rapid serological test
- *Indicator plants.* This method consists of grafting tissue from the suspected plant to an indicator plant. The virus moves into the host and causes symptoms in the indicator plant.

Immunological and indicator tests strengthen the reliability of the analysis, and they are the official techniques used to assess the presence of most diseases in candidate plants.

Figure 6: *Virus indexing procedures. Virus Indexing Lab (Badam Bagh) (a); ELISA test (b); clean material conservation (c) (J.I. Trives)*

3.3. Cleaning propagation material

It is not possible to cure a plant from virus diseases. But it is still possible to apply other methods in order to "clean" the selected material collected or to be used in nuclear nurseries, and obtain virus-free planting material (Figure 7).

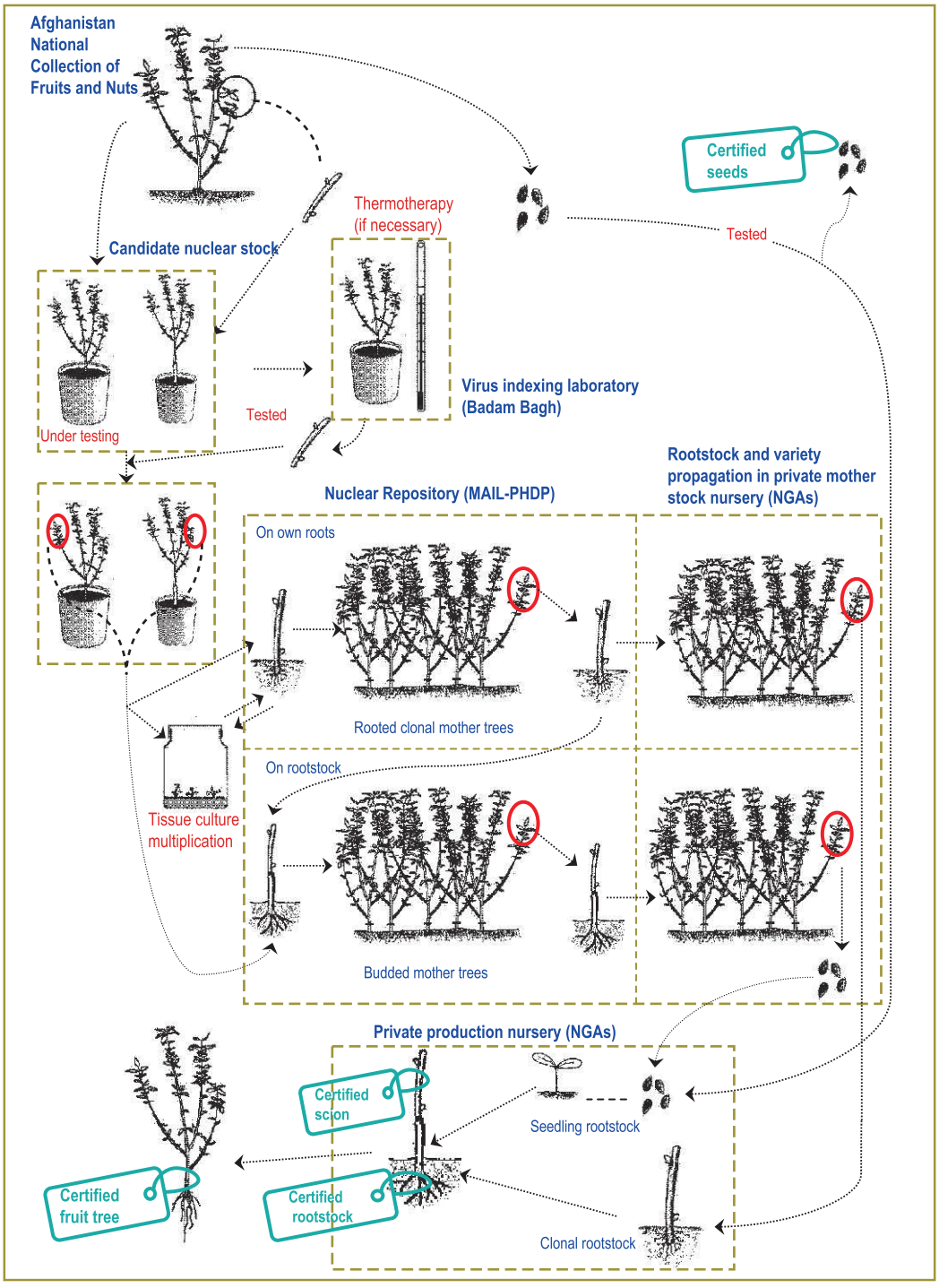


Figure 7: *Diagram of the stages of the certification scheme for production of virus-free propagation materials (rootstocks), and release to the fruit tree commercial industry (Source: EPPO, 2000)*

Cleaning material requires significant resources in terms of facilities, manpower (time and skill) and consumables. The most reliable and relatively efficient techniques for fruit tree species are thermotherapy and tissue culture. To clean a genotype through tissue culture techniques can take years in some cases. Thermotherapy appears to be more efficient, but cannot be adopted for all harmful diseases affecting fruit tree species; furthermore, the response to high temperatures (38-39°C) in a growing chamber is genotype dependant, requiring specific strategies to overcome this problem. In Afghanistan a cleaning strategy based on a combination of thermotherapy and tissue culture will be used.

Thermotherapy Thermotherapy takes advantage of the difference in development time of meristematic cells and the time needed for reproduction of viruses under high temperature. At 38-39°C viruses cannot "reach" the upper parts of the apexes grown under those conditions. The method is quite simple, since the materials to be cleaned are grown in containers within a heated and illuminated growing chamber for some weeks or months. The upper part of the new sprout will be then micrografted on a virus free plant, a seedling or rooted cutting. These plants can be obtained *in vitro* by embryo culture or rooting microcuttings.

Instead of micrografting, the cleaned "meristematic apexes" can be continued in *"in vitro"* cultivation, that is 'micropropagation". Special skills are needed to achieve efficiency in the *in vitro* cultivation of meristematic apexes (e.g. growing techniques, etc.) and especially on the explant preparation (the meristematic apex to be planted in vitro must be cute under a stereoscopic microscope in a laminar air flow cabinet). Specific protocols are available for the best practice of *in vitro* tissue culture for the different fruit tree species. By continuing the cultivation of the meristematic apex in culture with micropropagation, many explants can be obtained. This technique is particularly usefull for commercial propagation of large numbers of various important fruit tree rootstocks.

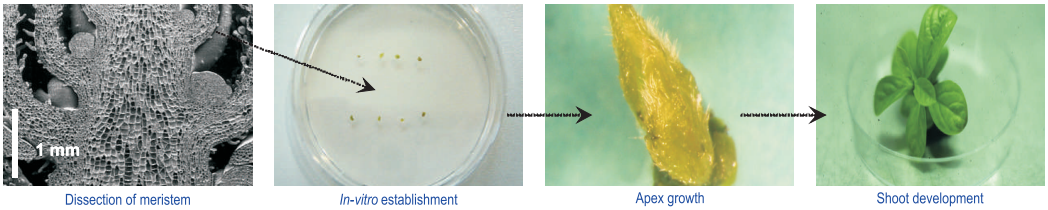


Figure 8: *Tissue culture technique (Adapted by E. Giordani)*

3.4. Conservation of cleaned nuclear material

Cleaned material is a high cost and valuable product that must be kept healthy. Safety replicates of cleaned nuclear stock plants must be conserved in insect proof screen houses (Figure 9).
The main critical points regarding conservation are the compliance with hygiene and indexing rules; for specific species, standardized protocols are available. Further, the care of the growth of plants is critical, in order to obtain explants (plant material) for the next pre-multiplication stage.

Figure 9: *Conservation of cleaned material in net houses (J./.Trives)*

Proper labelling of the propagation materials (nuclear stock, pre-multiplication or propagation stock of rootstocks and scions, and finally saplings deriving from their use) and keeping records of the entire process of production, is an essential procedure to preserve and obtain the greatest benefits from such superior materials.

Part 2

Mother stock nursery planning

In Part 2 you will find guidelines to facilitate the meetings of the nursery growers association in order to:

- Select the nurseries that will specialize in mother stock production
- Help growers define which varieties to produce and the quantity of each
- Guide nursery growers in the principles of mother stock nursery production

Mother plants are used to produce certified propagation material for the production of certified fruit and nut trees by registered nursery growers. The mother stock nurseries will produce certified propagation material for their own needs as well as for sale to other nursery growers.

The registered mother stock nursery will be a specialised nursery grower who is a member of one of the nursery growers associations registered in the Afghanistan National Nursery Growers Organization (ANNGO). The mother stock nursery grower has the important role of producing sufficient, certified propagation materials for distribution to other nursery association members.

The trainer of extension personnel and nursery growers may also have the role of nursery association facilitator; if so, you will have to supervise the selection of the mother stock nurseries from all the nursery candidates.

Photo E. Vernon

1. Guidelines for selection of the mother stock nurseries

1.1. Criteria for eligibility of mother stock nurseries

In consultation with the board members of the ANNGO, you will help in the selection of the nurseries that will become mother stock nurseries. The following is a set of criteria that the candidate nursery grower should meet:

- *The nursery grower or a member of his family is literate and numerate*
- *He has at least 5 years of experience in nursery growing*
- *He is skilled in budding or has staff with budding skills*
- *He is interested and willing to participate in training activities*
- *He understands the standards to be introduced for certification and is willing to follow those standards*
- *He is willing to keep written records of his nursery plants as required by the association standards*
- *He has sufficient financial resources for purchasing essential inputs like fertilizers, manure, crop protection products, basic tools, labour, signs and labels*

In addition, the nursery must be well organized and managed:

- *Good layout of plants in straight rows, with proper access paths*
- *Proper separation of young saplings and mature orchard trees*
- *Plants are uniform and healthy*
- *No serious weed problems are present*
- *No pest or disease problems are evident*
- *Plants are adequately irrigated*

In Annex 2 you can find templates to help in the evaluation of the eligibility of a mother stock nursery grower.

1.2. Basic information required for registration of mother stock nurseries

You have to make sure that you gather all the personal and farm information from the nursery growers. The following is a list summarizing the basic information to collect. You can also find the templates in Annex 3.

- Name, address and telephone number of nursery grower
- GPS coordinates of nursery
- Directions on how to reach the nursery
- Area of nursery (jeribs)
- Number of saplings sold in the past year with breakdown by species
- Expected number of saplings to be sold in the current year with breakdown by species

2. Guidelines for variety and mother stock nursery size selection

Once the mother stock nursery grower has been selected, it is important that all the members of the association get together and determine the basic requirements for mother stock trees: *Which varieties do they want to produce? How many mother plants will be needed to satisfy the requirements of the entire group?*

The following steps will help you facilitate the nursery growers' meetings during the selection stage.

Before the nursery growers' preparatory meeting

Step 1: Request the association to prepare sapling sales data for each member nursery by species and variety

- ***Objective:***

The objective of this activity is to collect data on the sales of saplings by the members of the association. This data will be used to estimate how many mother plants the association will need to plant in order to satisfy the bud requirements of all its members.

- ***Procedures:***

1. The chairman or another person designated by the association should complete the following documents:

1.1. Data collection form: each member will have a form containing sapling production information (Table 2)

Table 2: Example of a*nnual sales of saplings (previous year sales or current year projected sales)*

Fruit Species	Variety	Rootstock	Number of saplings sold
Apricot	*Amiri*	*Seedling rootstock*	*2500*
Apple	*Fuji*	*M 106*	*1500*
Apple	*Fuji*	*M 9*	*800*

2. The person responsible should be trained in the completion of the above documents

With the sales information provided, the person responsible should prepare a general table on sales of saplings for the entire association.

If the chairman is not able to collect data from all members (e.g. because they cannot be contacted or are absent), then he should at least try to include all of the larger nurseries.

During the nursery growers preparatory meeting

Step 2: Organize and conduct a "Mother stock nursery preparatory meeting" with the association

- ***Objectives:***

  The objectives of this meeting are:
  - To analyse data on the current annual sales of the association members in terms of number of saplings per species, variety and rootstock.
  - To help association members understand the programme for the distribution of saplings of mother stock trees and the development of mother stock nurseries.

- ***Procedures:***

  In Annex 5 you are provided with a suggested agenda for this meeting. During this preparatory meeting you will:

1. Present the data on annual sales of saplings by species and variety:

The person responsible should present available data on the sales of saplings. You should review this data together with the person in charge to make sure that the information is legible. You should also:

- ❑ *Check that the larger growers have been included*
- ❑ *If necessary, adjust (upwards) the numbers of saplings sold to compensate for any missing data.*

2. Explain the following key points:

1. ***Nursery growers will benefit by improving the quality of saplings***

- The Afghanistan National Nursery Growers Organization (ANNGO), the local associations, and the entire Afghan nursery industry will increase the value of the saplings they produce.
- The customers of the nursery industry are orchard growers that produce fruits and nuts.
- The domestic market for fruits and nuts is limited, therefore orchard growers must target export markets if they want to expand and prosper.
- In order to produce high quality fruits and nuts that can be exported to foreign countries and sold for higher prices, the orchard industry needs high value saplings (of good quality and good varieties).
- If the quality of Afghan fruits and nuts can be improved, then the demand from foreign countries will increase. Consequently, the orchard industry will expand and will require more saplings both for planting new orchards

Figure 10: *High quality saplings prepared for sale (E. Vernon)*

Figure 11: *Afghan fruit and nut exhibition in Firenze, Italy, 2008 (E. Giordani)*

and for replanting old orchards. Therefore, the nursery industry will be able to sell more saplings in the future.

- High value saplings are saplings that increase profits for fruit and nut growers.

- Nursery associations that produce high value saplings will be linked to projects that want to buy those high value trees (such as the World Bank's Horticulture and Livestock Project, NGOs, amongst others).

Figure 12: *Nursery growers select varieties in PHDC Kabul (E.Vernon)*

- Orchard growers will receive education about the importance of planting high value certified saplings.

- Orchard growers can see the benefits of planting high value saplings by visiting any of the six PHD Centres of the country, or their demonstration orchards, which are planted with material from the Afghanistan National Collection of Fruits and Nuts (you may want to contact the PHD Centre closer to your location for information regarding demonstration orchards.). The varieties will be the same ones that will be available from members of the nursery growers associations.

Figure 13: *Registered clones in the Afghanistan National Collection of Fruits and Nuts (L. Imburgia)*

- In the future, many orchard growers will only want to buy certified saplings from association members that meet certain standards. These standards will be supervised by the Ministry of Agriculture, Irrigation and Livestock (MAIL) and Afghan National Nursery Growers Organization (ANNGO) with assistance from the PHD Centres and the Afghanistan National Horticulture Development Organization (ANHDO).

- Eventually, the government will start to implement laws that will limit the sales of non-certified saplings.

Note that many of the saplings sold by the associations members are of unnamed (mahali or local) varieties. Therefore, suggest to the association members that it would be better to stop budding with these unknown varieties and instead use one of the listed varieties in the Afghanistan National List of Fruit and Nut Varieties.

2. The quality and value of saplings can be improved by using budwood from certified mother stock trees

- All the buds taken from a single tree are of the same clone. This means that these buds will produce plants with exactly the same characteristics as the mother tree, the *donor* plant.

- To produce certified saplings it is essential to only use certified budwood from registered mother stock trees, not from orchard trees.

3. *List of varieties available to develop mother stock nurseries*

Besides helping the association plan the number of mother stock trees required, you should start to encourage the association to think about which varieties to choose. The nursery growers should be given information about horticultural attributes, as well as market ranking of the available varieties and clones.

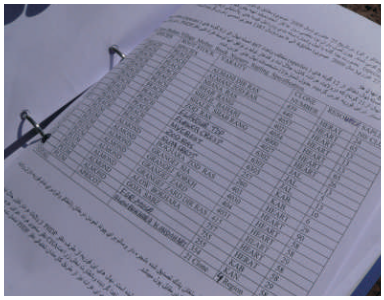


Figure 14: *List of varieties from the Afghanistan National Collection of Fruits and Nuts (L. Imburgia)*

- At this point of the meeting, you will provide the nursery growers with a printed list of the varieties and clones registered at the Afghanistan National List of Fruit and Nut Varieties kept at PHDP (contact the PHD Centre close to your location to request the list). All these varieties are included in the Afghanistan National Collection of Fruits and Nuts. The national list also includes all imported varieties for which mother stock plants have been registered.

- Explain what information is provided in the list of clones. Read out the headings of the columns in the table. Select some clones, as examples, and read out the data provided for those clones, e.g. the owner and location of the original in-situ tree from which buds were taken.

4. *Collective planning of the requirements for mother stock trees*

The association should work together as a group to plan their total requirements for mother stock trees, based on the information collected by the chairman about expected annual sales of saplings.

- Explain that certified mother stock plants should only be planted in mother stock nurseries and should only be used to produce budwood, *not* fruit.

- However, a few extra saplings can be provided to nursery growers who want to grow the saplings to maturity to produce fruit so that prospective customers can see the features of the variety. These demonstration trees should *not* be used to produce budwood.

- Mother stock trees should be pruned severely every winter to maintain the tree in a vegetative state. This means the tree will not be allowed to produce fruit and the buds taken from the tree will be vegetative (not flowering), so it will grow vigorously in the nursery. Severe pruning every year also means the mother stock tree will not grow as large as a mature orchard tree, and it will produce fewer buds per tree. However, mother stock trees can be planted closer than orchard trees, so the yield of buds per *jerib* will be high.

Figure 15: *Mother stock trees pruned for budwood production (E. Vernon)*

- Explain how to calculate the number of buds that a mother stock tree can produce:

  The number of buds produced by a mother stock tree will depend on many factors. Much depends on good vigorous growth which depends on good weed control, irrigation, soil type, and many other factors like timing of budwood collection and varietal variation (e.g. some varieties "feather" and produce flower buds which reduces vegetative bud availability). In Afghanistan, due to the warm climate and high light levels, growth rates can be very strong. After 5 years, one mother stock tree may produce 400 to 500 or perhaps more buds per year. In order to calculate how many mother stock trees will be required, you should assume a yield of about 250 buds per tree per year. It may take up to four years to reach this yield.

  The expected number of buds per mother stock tree is summarized in Table 3:

  Table 3: *Number of buds (per year) from one mother stock tree*

	Number of buds (per year) from one mother stock tree
Year 1	The establishment year will not yield useful buds and any extension shoots should be used to start the framework from which future budwood will arise.
Year 2	50 - 100 buds
Year 3	100 – 150 buds
Year 4	200 – 250 buds
Year 5	300 – 400 buds

- The nursery association should also calculate the annual bud requirement of all its members, and then plan for the mother stock nurseries to plant sufficient mother plants.

  Using the data of sapling sales provided, at the beginning of the meeting, divide the number of saplings of each variety by 250 to derive the number of mother stock trees required (see example in Box 1).

Box 1: *Example of a calculation of the number of mother stock trees required by a nursery*

Suppose the nursery sells 6,000 saplings of stone fruit and also expects to sell buds to other association members. In the example below, you are shown how to calculate the number of saplings (1) and buds (2) required per year, for each species and variety or clone for own use, and also to sell to others (3); the number of total buds required in a year (4) is then *divided* by the average estimated number of buds of a single mother stock tree (5), and the number of mother stock trees required of each variety and clone is obtained (6), and rounded up (7).

Species	Variety & Clone No.	No. of saplings to be sold per year (1)	No. of buds required per year for own nursery = 5% losses (2)	No. of buds required per year for sale to others (3)	Total No. of buds required per year (4)	No. of buds per mother stock tree (5)	No. of mother stock trees required (6)	No. of mother stock trees (rounded up) (7)
Apricot	**Amiri 276**	2,500	2,625	1,500	4,125	250	16.5	**16**
	Qaisi 465	2,000	2,100	500	2,600	250	10.4	**11**
	Charmagzhi 6310	1,500	1,575	300	1,875	250	7.5	**8**
Total		6,000	6,300	2,300	8,600		34.4	**35**

Note that a yield of 250 buds per tree is assumed, but this yield may not be achieved until 3 or 4 years after planting the mother trees. In this case, the nursery grower may not wish to sell buds to other nurseries until he has satisfied his own requirements.

- Also explain that it is not recommended to take buds from a mother stock tree in the first year after planting because this would spoil the development of the structure of the tree and thereby reduce the quality and number of buds produced in the future.

- It should be explained that members who own the *in-situ* trees should use only certified mother stock trees received from certified mother stock nurseries to produce certified saplings. They should not use their *in-situ* trees for production of certified saplings. *Remember: In-situ trees are meant to preserve the local genotype resources in the traditional way the farmers have managed them.*

- It is not necessary for each nurseryman to have mother stock trees for every clone. They can buy certified budwood from different registered mother stock nurseries. They should *not* use budwood from other sources. If budwood from other sources is used, then the saplings they produce cannot be certified. In the future it will become illegal to sell saplings that are not certified.

Mother plant will be used for producing high quality propagation materials (budwood, variety cuttings and seeds, cuttings and stoolbeds for rootstocks), to be distributed to the registered nurseries producing certified fruit tree saplings. To ensure high quality propagation material is available for all members, it is important that the mother plants are well managed. Therefore **it is recommended that only the best nurseries grow mother stock trees.**

Part 3

Mother stock nursery production management

After reading this section you will be able to develop training sessions about:

- How to plan, establish and manage a mother stock nursery
- How to produce mother stock propagation materials
- How to establish a traceability system for mother stock propagation materials

Field Trainings

The following section of the training will be “hands-on” work. A PHD Centre, a demonstration orchard, or a farm of one of the nursery association members would be a suitable venue for this activity.

To conduct this field activity you should divide the participants into groups of 4 or 5 persons, in order to give everyone the opportunity to perform the practical tasks.

Photo L. Imburgia

Field Training 1

Preparation and establishment of the mother stock nursery

The most important considerations for preparing and establishing the mother stock nursery include:

- Planting only certified saplings from an authorized source
- Proper site selection
- Carefully following the traceability instructions

1. Purchasing saplings for mother stock nurseries

For the establishment of a mother stock nursery, certified saplings will be available from the specifically authorised nurseries registered in the Afghanistan National Nursery Growers Organisation (ANNGO). As explained elsewhere in this manual, it is the intention to raise the standards of the original mother stock plants, for example, by removing viruses from original plant material.

You should explain that each sapling sold as mother stock must be accompanied by a certification label. In the case of imported material, in addition to the certification label, an official or commercial document (such as an invoice, packing list or delivery note) giving full details of the saplings, should be included. The certification label provides the following information:

- Date of production
- Species
- Variety/clone name and number
- Rootstock name
- Certification number (label number)
- Name and registration number of the nursery that produced the saplings (nursery code)

Figure 16: *Imported certified sapling with label (E. Vernon)*

2. Mother stock tree establishment

2.1. Materials needed

- ❑ Certified labelled saplings
- ❑ Measuring tape
- ❑ Thin rope for aligning plant rows
- ❑ Planting board
- ❑ Sticks for marking planting holes
- ❑ Manure
- ❑ DAP fertilizer
- ❑ Spades for digging
- ❑ Wooden signs for identifying the beginning of rows of a variety/clone
- ❑ Indelible (waterproof) marker pens (black colour)
- ❑ Damp hessian sacking to protect sapling roots during planting
- ❑ Buckets of water

Figure 17: *Materials for conducting the field training. (a) Damp hessian sacking to protect sapling roots; (b) Wooden signs for marking rows; (c) Well rotted farmyard manure (E.Vernon)*

What is written on a fertiliser's bag?

The fertiliser's bag has a formula written on it. It is very important that the farmer understands this formula. For example, in a bag of 23-21-15 starter fertiliser, 23% of the weight of the fertiliser in the bag is nitrogen (N), 21% is phosphorus (P_2O_5) and 15% is potassium (K_2O). This means, that one 50 kg bag of fertiliser contains (50 kg x 0.23 (% of N)= 11.5 kg) 11.5 kg of nitrogen.

2.2. Site selection for the mother stock nursery

It is important that the participants understand that the selection of an appropriate site is one of the most important aspects in nursery production. Use the following check-list in your field training:

- ❑ The location for planting mother trees should not have been previously used for growing fruit trees (saplings or mature trees) in the previous two years.
- ❑ The site should not be subject to flooding, and it must be protected from livestock.
- ❑ It is essential that the site has easy access to clean irrigation water all year round.
- ❑ Ideally, the soil for the nursery should be deep, loamy sand, intermediate texture, and have good drainage.

- There should not be any other fruit plants (neither saplings nor mature trees) within 5 meters of the mother trees.
- The site should be of sufficient area to accommodate the required number of mother trees planted 1.2 meters apart in rows 3 meters apart (refer to the example of calculation of number of mother trees explained in page 20). A minimal distance of 5 meters should be allowed between the mother stock trees and any other fruit trees. Additional land for expansion of the block of mother stock trees is desirable. A gap of 2.4 meters should be left between different clones planted in the same row (Figure 18).

Figure 18: *Mother stock nursery in PHDC Herat, spring 2009. Proper variety identification and 2.4 m gap separation between varieties (L. Imburgia)*

- It is recommended to plant windbreaks consisting of trees or shrubs to reduce and redirect wind, especially in areas of persistent, high speed winds (see also Manual 4 of *The Orchard Management Series*). *Salix* and *Populus* are species very easy to propagate from cuttings. Small cuttings (5 to 10 cm long) with a good bud can be planted in the nursery, grown one year, and then planted out (Figure 19).

Figure 19: *Poplar windbreak nursery in Herat (L. Imburgia)*

- It is important to consider elevation of the sites. Freezing air flows from higher slopes down to flat lands at lower elevations forming "frost pockets". This effect can also occur if a physical obstruction such as a topographical barrier (e.g. impermeable windbreak) creates an "air dam (Figure 20).

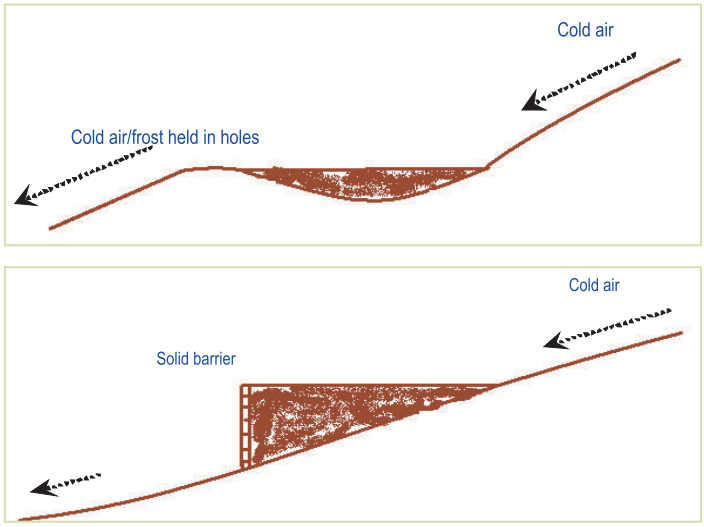


Figure 20: *Frost pockets created by (a) natural holes; (b) effect of solid barriers preventing drainage of cold air (adapted from Adams et al., 2008)*

2.3. Site preparation

Explain to the participants the main land preparation steps that they should perform prior to planting:

- *Soil structure and fertility:* If the soil has high clay content, then (if possible) add sand to loosen the soil for good aeration. If soil structure is very poor, explain that it could be modified with large amounts of aged sawdust, or well-composted animal manure. These practices can improve water retention, tilth, and fertility.
- *Tillage:* The soil needs deep sub soiling (30 – 35 cm deep), and then must be left to sun-dry for a few days. This practice will help reduce the weed and soil pathogen population, as well as improve soil aeration. Thorough tillage should be followed by a fine cultivation just before planting.
- *Levelling:* Level the nursery land, and correct if necessary any drainage problem by ditching, levelling, or raising the beds at least 45 cm above the top of the high water table.

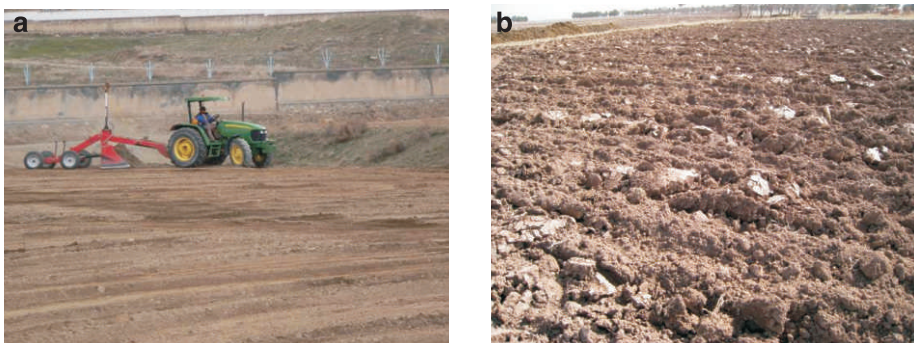


Figure 21: *Thorough soil tillage (a) followed by levelling (b) (L. Imburgia)*

2.4 Map of mother plants

- Use a pencil, ruler and piece of paper to make a map showing the positions of the mother plants in the nursery before planting.
- The map should show the row numbers, the varieties and numbers of mother plants of each variety in each row. It should also show neighbouring features like roads, irrigation channels, buildings, walls, windbreaks, etc., and the direction of north. Identification of the nursery such as the owner's name and village should also be added (see Annex 7).

Figure 22: *Training in drawing planting map (E. Vernon)*

- The map will help minimise the splitting up of plants of the same variety between different rows and also minimise the amount of land wasted on providing gaps between different varieties in the same row.
- The map will be used as a reference document when inserting signs at the beginning of each row and variety/clone and when planting the mother trees.

2.5 Nursery layout

Explain to the participants the detailed steps to mark out the plantation site:

- Measure and mark the planting positions in straight rows: 1.2 meters within the row x 3 meters between rows.
- Use the 3-4-5 triangle method to make rows at right angles to the base line.

Figure 23: *Marking plantation site (E. Vernon)*

- Describe the use of a planting board to position marker sticks on two sides of each hole.
- Dig planting holes: approximately 60 cm wide and 60 cm deep. Loosen the soil at the bottom of the hole.
- Place the top 30 cm of soil on one side of the hole and the bottom 30 cm on the other side.
- Prior to planting, mix 2 spades of well rotted manure and 100 grams of DAP fertilizer with the soil from the bottom of the hole. Thoroughly mix another 100 grams of DAP with the soil from the top of the hole.
- When planting, return the bottom soil to the bottom of the hole and the top soil to the top of the hole.

Figure 24: *Use of planting board for correct tree positioning (E. Vernon)*

Figure 25: *Digging planting holes and preparation for planting (E. Vernon)*

2.6. Signage for mother stock trees

This part of the training is very important. You should emphasize very strongly that well organized and focused work is required when managing variety, labelling and filling forms. **Insist on the importance of following the instructions exactly!**

- Each plant should already have a label attached before it was dug from the original nursery.
- Each lot of plants for one variety must be labelled in ascending order before planting the saplings which will become the mother trees.
- The location of each clone in the nursery must be marked with signs before planting commences. Signs should be inserted at the beginning of each row and also in front of each group of plants of a variety in a row. Every sign identifies the row number and variety name and number (Figures 26 and 27 b).
- Numbers should be marked with black indelible markers or paint.

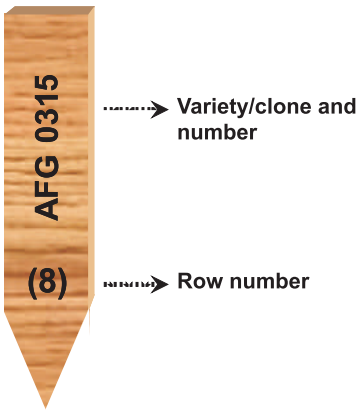


Figure 26: *Wooden sign for mother stock tree rows*

Figure 27: *Mother stock tree with certification label (a); mother stock trees with proper signage (b) (L. Imburgia)*

Very important!
Plants of the same variety must be kept in the same row.
Leave a gap of 2.4 metres between different varieties when planting in the same row.

2.7 Handling certified documentation of saplings

- When the nursery growers receive the certified saplings they have to:
  - Open each parcel and ensure that the traceability document (e.g. commercial invoice, packing list or delivery note) corresponds with the contents of the parcel
  - Check the certification labels of the saplings
  - Check if any of the materials listed in the document are missing

- Then, they must close the bags, and keep them in a cool shady place and proceed to plant as soon as possible.

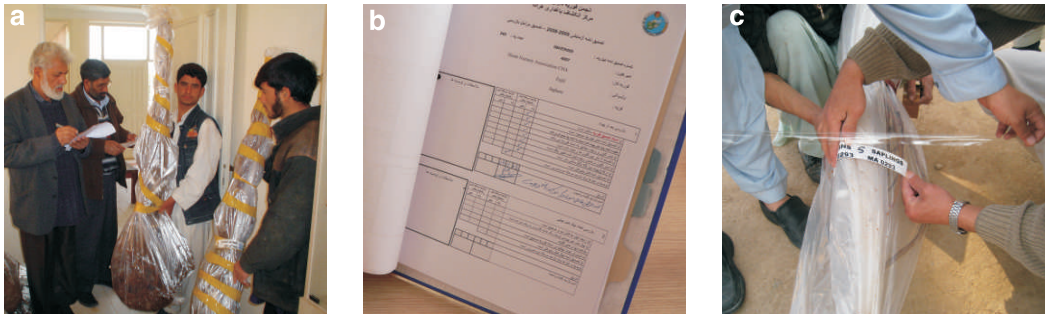


Figure 28: *Monitoring and handling certified sapling documents. (a) Reception of saplings; (b) Traceability document control; (c) Labelling sapling bags with the mother stock codes (M. Khademi)*

3. Planting mother stock saplings

Explain to the participants step by step how to organize and perform correct planting of the mother stock trees. A responsible person, such as the nursery owner or manager, or technical officer from the nursery growers' association (NGA), should supervise the planting of the saplings. This activity should be performed by the end of the winter. Use the following list as your field check-list:

- Plant only one variety/clone at a time.
- Take the bags containing the saplings for one variety/clone to the planting area.
- Check the mother stock map to see where the saplings of that variety should be planted. Hand over the saplings to the planter at the exact labelled row.
- After the plants of one variety have been planted, count the plants, check the labels, check the row number and check that all these details correctly correspond with the mother stock map.
- Then continue with the next variety/clone and repeat the above procedure.

Figure 29: *Preparation for planting saplings. (a) Sapling reception (M. Khademi) (b) Saplings protected from drying out (E. Vernon)*

- Plant the saplings as soon as possible after they arrive on the farm (taking into account suitability of the weather and soil conditions).
- During the planting operation, remember to keep the roots of the saplings covered with a damp material during the time between removal from the packaging and planting in the soil. Roots can easily become dry and be damaged by sunshine and wind. Such root damage can cause poor growth after planting.
- If plants have to be stored for more than a few days, they can be removed from the packaging, heeled into a shallow trench in a shady place, the roots covered with sawdust or soil, and watered.
- Instruct workers and make sure they are well aware of the following points:
  - The sapling should be planted on a slight mound approximately 8 cm above the ground level - this is to allow for rotting of the manure and settling of the soil in the planting hole and to avoid the root collar sitting in water during irrigation.
  - Use the planting board to position the plant in the correct place and to gauge the correct planting height (as explained in section 2.5).
  - The soil in the hole should be gently firmed with the foot.
  - Irrigate immediately after planting.

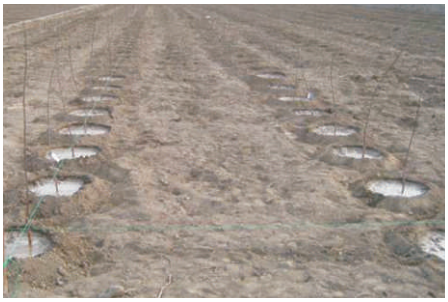


Figure 30: *Sapling planted on a slight mound and irrigated immediately after planting (E. Vernon)*

4. Establishing stoolbeds for rootstock propagation

Explain to participants that mother stock trees can be registered to produce clonal rootstocks in stoolbeds. Describe step by step, the principles of stoolbed production and management:

- The multiplication of plants in stoolbeds is called layering. This process allows developing new plants by rooting stems attached to a mother plant.
- Stems of the mother plant are covered with a growing medium to exclude light, increase the moisture level, and stimulate root growth.
- Mechanical treatments are used to stimulate rooting such as wounding the stem in some form (girdling, incision, bending, or cracking) in order to slow or block the downward movement of nutrients, hormones and other organic translocates. Rooting occurs just above the point of blockage.
- Once roots are formed, the new plant (layer) can be dug and transplanted to the desired location.
- Two main layering techniques are in use in Afghanistan: mound layering and trench layering.

(a) Mound layering or stooling (Figures 31 and 32)**:** this is one of the simplest and most cost effective forms of layering. The process of stooling involves, initially, the establishment of the mother plant which is then cut back to a very short stub (called *stool*), once it has become dormant.

- *Winter year 1:* The plant is cut back up to the surface level or 4-5 cm over the soil surface, during the dormant season. This will produce a thick root neck. The dormant buds will produce new shoots in the spring.
- *Summer year 1:* It is necessary to mound soil over the new shoots as they grow 10-15 cm high. If available, sawdust is an excellent material to use for mounding the layers. Roots will develop at the bases of the young shoots.
- *Winter year 2:* Remove the layers (rooted stems) in the dormant season and transplant.
- *Summer year 2:* These rootstocks can be lined out in the nursery and budded with a scion variety in summer, grown for the next year and sold. Or the shoots rooted can be removed at the end of the season, grafted with a desired scion variety in winter, stored, planted in a nursery row the next spring, grown for that year and sold.

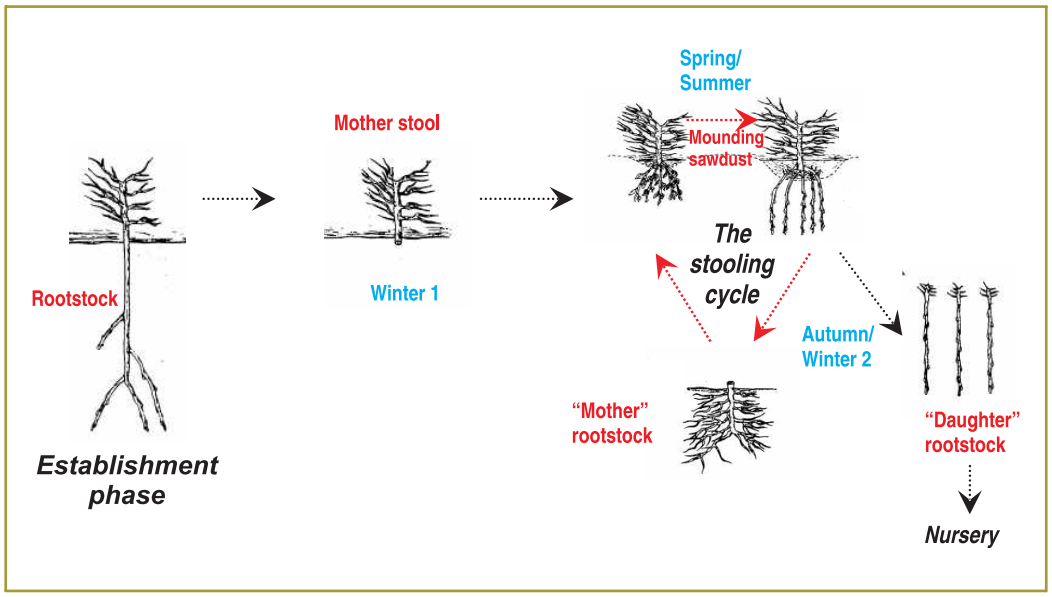


Figure 31: *Diagram of mound layering or stooling for rootstock production (Source: Adapted from Hartmann et al.,1997)*

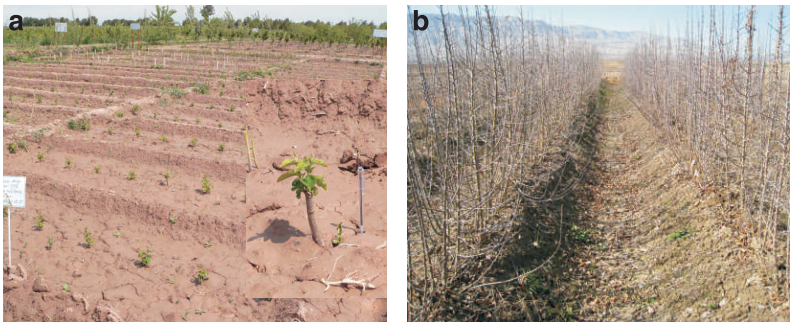


Figure 32: *Clonal apple rootstock propagation. (a) New stoolbed in spring (L. Imburgia), (b) Stoolbed in production (Source: AKF)*

(b) Trench layering (Figures 33 and 34)**:** Trench layering method consists of placing a longer branch in a trench and covering it with soil. This method produces several new plants from each layered branch. Trench layering is useful on plants whose buds will break and start to grow under the soil surface. The entire branch, except the tip, is placed in a trench and covered with soil.

- *Winter year 1:* Keep the tree completely flat with pegs or wire fasteners or inserting the tip of one to the base of the following.
- *Summer year 1:* Fill around new shoots as they develop with soil, bark, sawdust or other rooting material to cause etiolation of stems. Apply first layer before buds swell. Repeat layering as shoots emerge and before they expand. Leave no more than half of the shoot exposed.
- *Winter year 2:* At end of the season remove the medium and cut rooted layers close to parent plant.

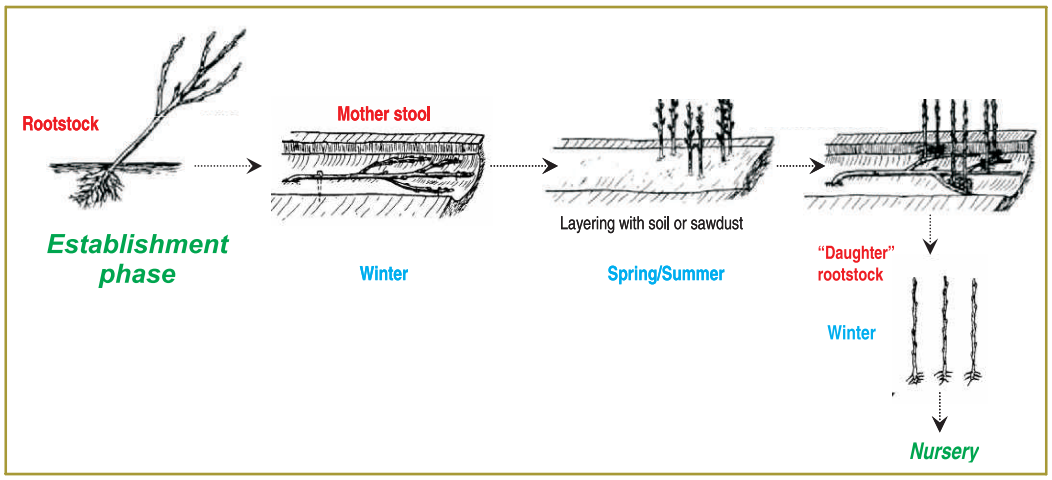


Figure 33: *Trench layering diagram for rootstock production (Source: Adapted from Hartmann et al.,1997)*

Figure 34: *Clonal apple rootstock propagation: trench layering (L. Imburgia)*

Field Training 2

Mother stock nursery management

The most important considerations in the management of the mother stock nursery include:

- Mother stock tree registration for producing certified propagation materials
- Timely cultural activities, including an integrated farming approach
- Initial training of mother stock plants: *proper formation pruning*
- Budwood collection starts the second year after plantation

1. Registration of mother stock plants

At this point of the training you will explain to the participants that the mother stock nursery should apply for registration of the mother stock plants and stoolbeds with the certification authority (ANNGO-PHDP). Mother stock trees will be registered in blocks of plants of the same variety. The process for registering the mother stock plants is the initial step of the certification procedure that will be explained in the *Field Training 4* of this manual.

2. Irrigation

Explain to the participants that a small bund should be formed around the planting hole to retain the water when irrigating immediately after planting. For proper irrigation management of the nursery, explain to the participants the following steps:

- ❑ Immediately after planting give each mother plant two buckets of water to wet the soil and to help settle the soil in close contact with the roots.
- ❑ After all the plants have been planted, make a furrow irrigation system (for example dig one furrow down each side of the rows of plants, i.e. 2 furrows per row) and irrigate the plants again the next day.
- ❑ Irrigate regularly according to the weather, type of soil, stage of growth and size of the plant.
- ❑ If an intercrop is grown try to irrigate the intercrop separately from the mother plants, for example, by using separate furrows, so that the intercrops and the mother plants are irrigated according to their own needs.

Figure 35: *Irrigation of mother stock trees after planting (M. Khademi)*

3. Weed control

Weeds compete with the mother stock trees for water and soil nutrients. For this reason, it is important to keep the area surrounding the tree weed-free for a distance of at least 1 metre. Weeds can be controlled by hand weeding and shallow hoeing. Do not dig the soil deeply within 1 meter of the tree because this will damage the feeder roots that grow close to the surface.

Figure 36: *Hand weeding in spring (L. Imburgia)*

4. Pest and disease management

In this part of the training, you should explain to nursery growers the basic principles of pest and disease management in the nursery:

- Highlight the distinction between pests and diseases. Horticulture pests can be a mammal, bird, insect, mite or nematode that is damaging to plants. Horticulture disease is an unhealthy condition in a plant caused by a fungus, bacterium, virus or virus-like organism.
- For pests, biological control can be a major form of control in a nursery or orchard where predators and parasites are encouraged. For diseases, however, in the natural environment, plant resistance (rather than biological control) is the important control method.
- Nursery growers can have access to many different kinds of control within a plant or crop cycle in order to bring about a precise and efficient pest and disease control. In almost all cases, a combination of measures will provide the most satisfactory and long-term pest control.

Figure 37: *Identification of insect damage (E.Vernon)*

- A programme of control against a pest or disease should consider non-pesticide controls first before relying on chemicals.
- There are many ways to manage pests with means other than pesticides. They include:
  - *Cultural control: using the right pruning, fertilising or watering regime, or selecting pest-resistant varieties or species*
  - *Physical control, for example, using mulches to keep weeds from growing, or solarization for soilborne pathogens or weed seeds*
  - *Mechanical control, for example hoeing weeds, using traps or creating barriers to exclude pests*
  - *Biological control: using beneficial organisms such as insects that prey on the pests or parasitize other insects*
  - *Replant: in extreme cases, where a plant requires regular pesticide treatment, consider replanting with a more pest-resistant species or variety*

5. Fertilisation

The fertiliser applications required to produce the desired plant growth vary according to the type of plant, climate, season of growth, other sources of nutrients applied and the nutrient status of the soil. Here you will find a general advice to assist participants in understanding a fertilisation plan for the mother stock nursery:

- In the first growing season, apply 50 grams (about 1 clenched fistful) of urea fertiliser to each mother tree 3 times during the growing season. Apply in April, June and September (total 150 grams).
- Sprinkle the fertiliser around the plant at a distance of about 40cm from the plant.
- Lightly till the fertiliser into the soil to prevent it from washing away and then immediately irrigate the trees to wash the urea down into the soil. If the urea is left on the surface, exposed to the sun, the nitrogen content will fall because the urea will release ammonia gas into the atmosphere.
- In the second growing season and subsequent growing seasons, the amount of fertiliser can be increased because the mother plants will be larger and nutrients will be removed with the budwood that is collected each summer. The following types and amounts of fertiliser are suggested:

April	*50 grams*	*Urea*
May	*50 grams*	*15:15:15*
June	*50 grams*	*Urea*
July	*50 grams*	*Urea*
August	*50 grams*	*15:15:15*
September	*50 grams*	*Urea*

6. Training of mother plants

- Mother stock trees should be trained to produce good quality budsticks that can be easily collected without climbing a ladder.
- The best time to prune mother plants is just before flowering time.
- Sterilise the secateurs with a disinfectant (such as bleach, sodium hypochlorite or alcohol) between pruning different clones to avoid spreading diseases between clones.
- If at the time of planting, any plants have started to leaf out, then all green shoots should be cut off to reduce water loss from the plants.
- Trim any damaged branches by making a clean cut just behind the point of damage.
- Remove any suckers growing from the rootstock.

- *Winter year 1:* Cut the main stem at height 75 - 100 cm from the ground (Figure 38).
  - If the sapling is small with no side branches cut the main stem at the lower height (75cm).
  - If it has good side branches below 100cm height, then cut the main stem above the side branches but not higher than 100cm.
  - If the sapling has side branches but they are higher than100cm, then cut the main stem at 75cm.
  - This pruning of the main stem will promote the growth of side branches that will be used to produce bud-sticks in the second year.
  - After cutting the top, do *not* cut any of the side branches but use string and pegs to tie down the longer branches to a horizontal position.

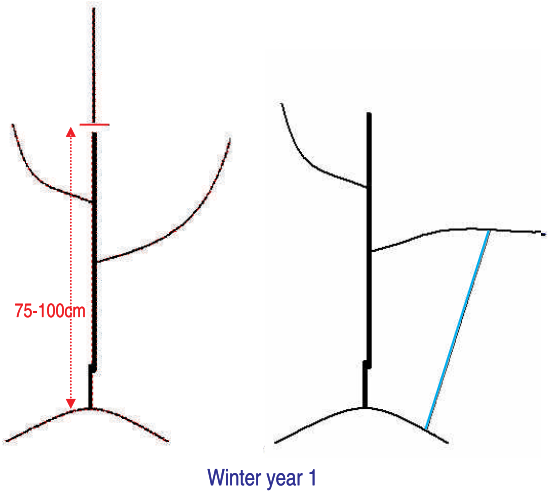


Figure 38: *During winter of year 1, the main stem should be cut 75-100cm from the ground*

- *Summer year 1*: When new side branches have grown long enough (e.g. over 60cm) they can also be tied down (Figure 39).
  - The strings can be removed as soon as the branches have lignified and are stiff enough to remain in position. After removing the string, the branches may spring up a little but this does not matter.
  - The reason for tying down the longer branches is to make a wider plant with a flat table-top shape that can capture more sunlight to produce vigorous vertically growing budsticks that can be easily collected in the following years.
  - Budsticks should not be collected in the first growing season because this would weaken the tree and reduce the quality and yield of budsticks in the next year.

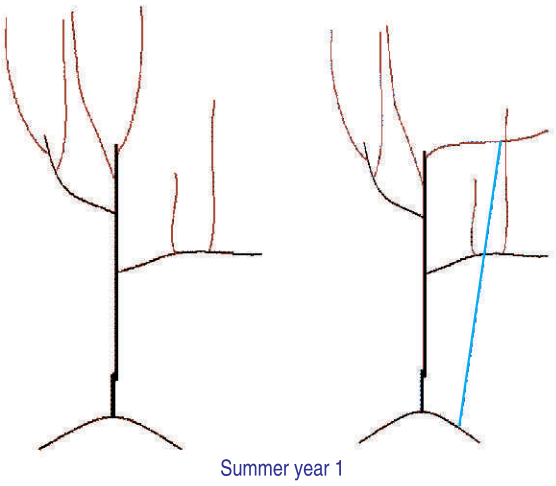
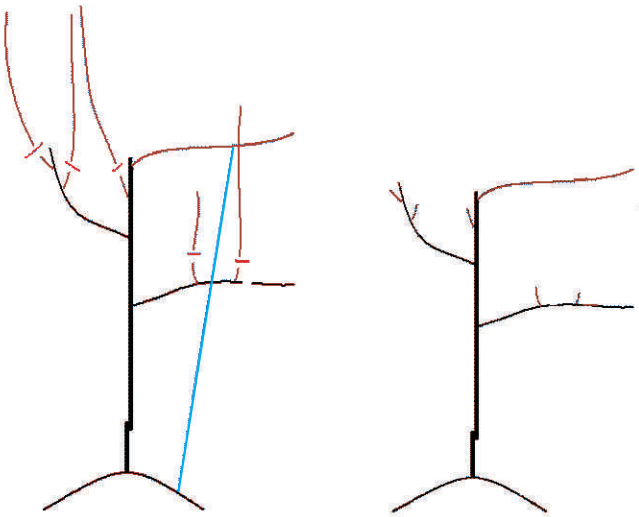


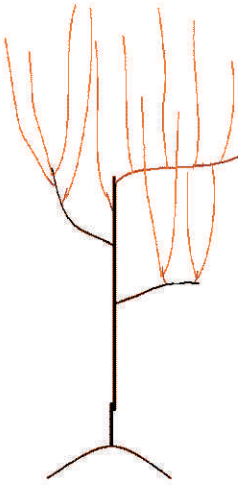
Figure 39: *Use string and pegs to tie down strong side branches. Do not take budwood during the first growing season to allow strong growth of the tree.*

- *Winter year 2:*
  - Cut back all vertically growing shoots to 2 – 4 buds if they are strong or just 1 – 2 buds if they are weak (Figure 40). These buds will produce new shoots that will become budwood later in the summer.
  - Some thinning of branches may be required. Overcrowded branches produce budwood of low quality.
- *Summer year 2:*
  - When collecting budwood, cut vertical shoots of adequate size (Figure 41) but leave 2- 4 buds to produce next year's crop of budwood.
  - This process will be repeated every year and will cause the height of the mother plants to gradually increase.



Winter year 2

Figure 40: *During winter of year 2 the side branches are cut back to promote new shoots to produce budwood in the following growing season.*



Summer year 2

Figure 41: *The mother tree is ready to start budwood collection.*

Figure 42: *Mother stock tree pruned and tied to promote new shoots in the spring (L. Imburgia)*

Budsticks should not be collected in the first growing season because this would weaken the tree and reduce the quality and yield of budsticks in the next year.

Field Training 3

Production of certified propagation materials

The most important considerations in collection and preparation of propagation materials include:

- The propagation material must be kept alive and in good condition; protected from drying out, heat, and freezing
- The propagation material must be properly identified Budwood and cuttings must be collected and preserved in correctly labelled bundles
- Careful planning of the budwood collection is required:
  - Preparation of materials needed in advance
  - Proper coordination of budwood collection distribution and budding

1. Budwood collection

The collection of budwood has to be done early in the day while temperatures are cool and the plants are still fully turgid. For this reason, it is very important to prepare all the required materials the day before the training.

It is extremely important that you emphasise to the participants that if they suspect of any virus symptoms on leaves (see Part 1 of this manual "Virus detection"), they must contact the PHP Centre close to their location.

1.1. Budders

It is very important that an experienced budder participates in this session to discuss bud quality. Emphasise that **it is extremely important that growers coordinate the budwood collection with budwood distribution and budding**. Experienced budders have to be available the day following the bud collection.

1.2. Materials needed

- ❑ Cold boxes of at least 50 cm depth
- ❑ Ice
- ❑ Plastic jars, to keep the ice and prevent running water inside
- ❑ Secateurs
- ❑ Alcohol or other disinfectant
- ❑ Sprayer
- ❑ Pieces of clean cloth
- ❑ Thin plastic bags: 50 cm x 20 cm
- ❑ Tape to seal the plastic bags
- ❑ Electric insulation tape or specialist budding tape
- ❑ List of budwood to be collected
- ❑ Traceability documents: certification labels, registration book ("the mother stock nursery book"), and mother stock nursery map

Figure 43: *Training materials for budwood collection (L. Imburgia)*

1.3. Procedures

You should conduct this training during the growing season. You must make sure that the participants understand that the material collection can only be certified if every step is done in accordance with the certification instructions and traceability procedures.

Check-list to prepare propagation materials:

- ❑ *Ice preparation:* Ice to fill the containers should be available the same morning of the budwood collection. Ice will always be kept inside a closed container to avoid free water inside the cold box (this would make the ink on the labels run).
- ❑ *List of budwood to be collected, registration book and certification labels:* Use a plastic folder to keep the documents clean and dry.
- ❑ *Mother stock map:* Include it in the plastic folder.
- ❑ *Labels on mother stock trees:* Check that all the mother trees have their labels and correspond with the map and signage.
- ❑ *Budstick bags*

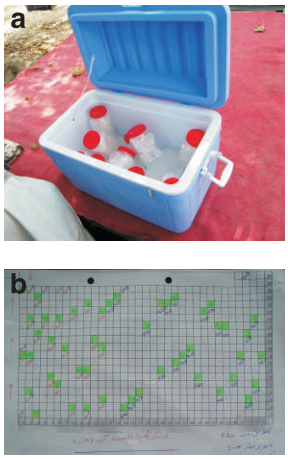


Figure 44: *Preparation for bud collection. (a) Ice preparation (J.I. Trives); (b) Mother stock nursery map (M. Athar)*

Check-list to collect budwood:

- ❑ Check the list of budwood, the mother tree map, signs and row numbers to know which tree to collect budwood from.
- ❑ Wet the cloth for collecting budwood and place it under the shade of the variety block.
- ❑ Place the cold box in the coolest place available near the mother tree.
- ❑ While standing next to the mother tree from which budwood will be collected, complete the certified budwood label (see *Field Training 4* for a label sample) and attach it to the variety/clone budwood bag.
- ❑ Disinfect cutting tools with alcohol.
- ❑ Collect wood of the current growing season. Ideally, you will find at least 10 good quality buds on the central part of a shoot, discarding the terminal and basal parts.
- ❑ As the shoots/branches are cut, keep them in a wet cloth.

Figure 45: *Budwood collection. Cool area for operations (a); Disinfection of hands and tools (b, c); Budwood collected from the current growing season (d) (J.I.Trives)*

Check-list to prepare the budwood after collection:

- ❑ Find a shaded and cool area to work.
- ❑ Take one branch out of the wet cloth.
- ❑ Select a central portion containing adequate buds.
- ❑ Remove the leaves but keep the petioles intact (they will be used as handles to insert buds into the rootstocks).
- ❑ Cut all the sticks to a uniform length. Keep their basal ends together, and tie them in bundles of known quantity (for example, 10 budsticks per bundle).
- ❑ Put the budsticks carefully inside the labelled plastic bag, do not tear the bag, fold the opening.
- ❑ Check that the bag is correctly labelled and put this bag inside a second plastic bag to protect the label.
- ❑ Once the number of budsticks for one bag is completed, seal the bag with the tape provided and place it inside the cold box (be sure to close the cold box lid immediately to maintain a low temperature).
- ❑ Fill the registration book (Annex 6), the "mother stock nursery book".
- ❑ Proceed to the next lot of budsticks
- ❑ Disinfect tools and repeat the above procedure.

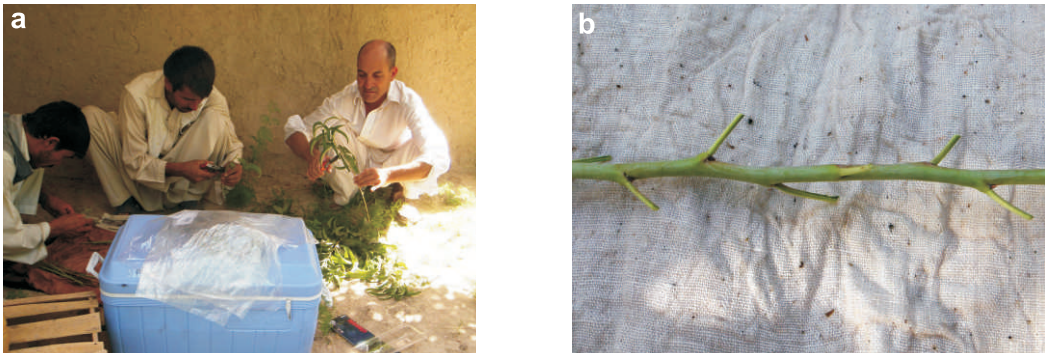


Figure 46: *Budwood is prepared in a shaded, cool area (a). Leaves are removed keeping the petioles intact (b) (J.I. Trives)*

IMPORTANT!
Change the budding preparation area after finishing collection for every variety.

2. Cutting collection

Dormant hardwood cuttings (stem cuttings taken during the dormant season) are the easiest type of stem cuttings to grow. These cuttings are collected during late autumn through late winter, after trees drop their leaves and when stems are firm. Fruit trees propagated by hardwood cuttings include citrus, grape, pomegranate, and fig. Many clonal rootstocks are also propagated by cuttings.

Cuttings can be produced using dedicated mother trees established and managed according to the guidelines already provided above for budwood.

2.1. Materials needed

- ❑ Cold box for transport
- ❑ Secateurs
- ❑ Alcohol or other disinfectant
- ❑ Sprayer
- ❑ Plastic bags and labels for cutting bundles
- ❑ Tape to seal the plastic bags
- ❑ List of cuttings to be collected
- ❑ Traceability documents: certification labels, registration book ("the mother stock nursery book"), and mother stock nursery map

2.2. Procedures

The proper time to conduct this training is during the dormant season. You must make sure that the participants understand that the collection of materials can only be certified if every step is done in accordance with the certification instructions and traceability procedures.

- ❑ The cuttings are collected during the dormant season.
- ❑ It is important that nursery growers start cutting collection before the first growers start with pruning operations to avoid good cuttings being taken away for firewood.
  - ❑ *Find out the normal pruning dates in the different districts of your area.*
  - ❑ *Depending on the species or variety, decide the date you want to start the operation. Request advice from the PHD Centres (In most cases not later than late January to middle of February).*
  - ❑ *Prepare the list of cuttings required in advance.*
- ❑ Check the list of cuttings, the mother tree map, signs and row numbers, to know which tree to collect cuttings from.
- ❑ While standing next to the mother tree from which cuttings will be collected, attach the correct label for that variety/clone to a cutting bag.
- ❑ Spray the cutting tools with disinfectant.
- ❑ Proceed to take the cuttings according to the specific recommendations for each species (see 2.2.1 and 2.2.2. below).
- ❑ The completed cuttings should be grouped according to length and tied in bundles of 20 with the cut ends together.
- ❑ Put each bundle into a plastic bag, fix the correct label and seal it with tape.

- Check that the bag is correctly labelled. Put this bag inside a second plastic bag to protect the label.
- Check that the correct number of cuttings has been collected in the cutting list.
- Place the bundle inside the cold box (be sure to close the cold box lid immediately to maintain a low temperature).
- Fill the mother stock nursery book.
- Spray the cutting tools with disinfectant and proceed to collect the next lot of cuttings.

IMPORTANT!
Change the cutting preparation area for every variety.

2.2.1. Procedures for grape vines

Hardwood cuttings of grape vines

- The cuttings are taken from the canes and removed from the registered mother stock vines.
- First get enough canes from the mother vine and then proceed to prepare the cuttings. In the case of grapes, a trellis system (1 meter tall) should be used whereby new canes can be trained to grow vertically by lifting up 2 wires, one on each side of the trellis, with the new canes trapped in the middle to prevent them from flopping over.
- Straight, vigorous, well-matured, one-year-old canes with well-developed buds should be chosen for cuttings.
- Choose clean, healthy wood with no discolorations from fungus or other diseases.

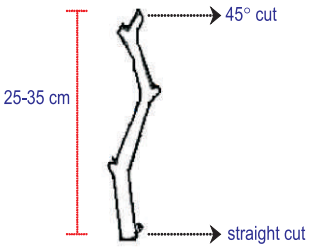


Figure 47: *Grape vine cutting*

- The best cuttings are made from canes about pencil-size or slightly larger (0.8 – 1.5 cm in diameter). Best wood is dense and light green inside with relatively small pith. Avoid wood that is soft and spongy and has large pith.
- Make cuttings four internodes long (with five buds 5 - 10 cm apart). This will make an ideal completed cutting 25 – 35 cm long.
- Make the bottom cut straight (that is the portion that will form roots) just below the bud or node and the upper cut at an angle of about 45 degrees, 2 cm above the bud or node. This is so that the cutting will be planted upright.

2.2.2. Procedures for pomegranate cuttings

Hardwood cuttings of pomegranate

- The cuttings are taken before the end of bud dormancy (around 1st to 20th of February).
- Straight, vigorous, well-matured, one-year-old shoots (water sprout shoot) with well-developed buds should be chosen for cuttings. The best cuttings are made from shoots slightly thicker than pencil-size (0.8 – 1.5 cm of diameter). The length should be 30 cm.
- Collect preferably wood of one year growing season (if required you can use two year wood or combination, but avoid younger than 6 months or older than two years) (Figure 48).The cutting wood should be dense and light green and the central section of the cutting should not be too yellow.
- Make the bottom cut straight just below the bud or node and the upper cut at an angle of about 45 degrees, 2 cm above the bud or node. This is so that the cutting will be planted upright.
- Remove all lateral branches and thorns before bundling.

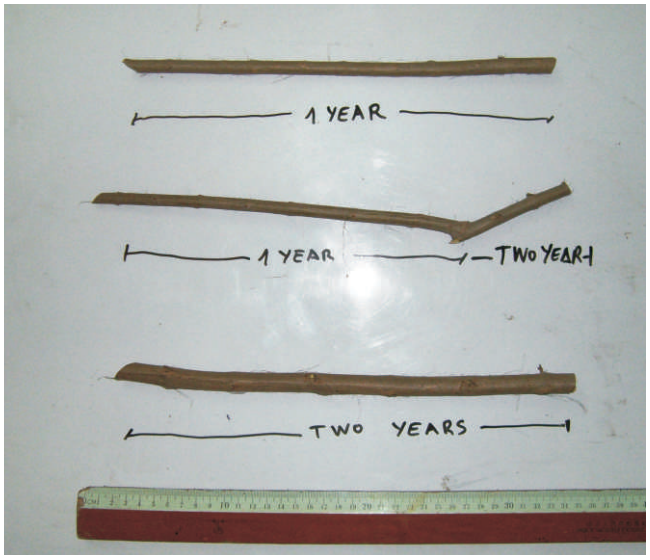


Figure 48: *Pomegranate hardwood of different ages for cutting propagation (J.I.Trives)*

3. Seed collection for certified rootstocks

Mother stock nurseries will deliver certified seeds for rootstocks to supply nursery growers. Certified seeds will be recognized by the certification label on the front of the bag.

For several fruit tree species, seedling rootstocks are used for propagating commercial varieties. These include almond, peaches, apricots, plums, and pears, amonges others. For other species, e.g. apples, this method is not practical because they produce, when budded on seedling rootstocks, very large and vigorously growing trees. These trees make pruning, harvesting and pest management very difficult. Hence, for such species, the use of seedling rootstocks is not recommended.

Please refer to Manual 3, part 2 for a complete overview of these concepts.

Figure 49: *Apricot seed tree (J.I.Trives)*

You can find a detailed explanation of seedling rootstocks in Manual 3 **"The fruit tree production nursery".**

If you have access to a computer and projector, you may like to show the following presentation during the growers' association meeting (click below):

PRESENTATION No. 2: "The mother stock nursery".

Field Training 4

Certification of propagation materials

1. The ANNGO Fruit Tree Certification Scheme

In March 2009, the Afghan National Nursery Growers' Organization (ANNGO) and its members began the implementation of a fruit tree certification scheme that aims to provide commercial fruit growers with certified true to type fruit tree saplings. In the future, the certified fruit tree saplings will also be proven in terms of health and vigour.

All of the local nursery growers associations (NGAs) that are members of ANNGO have one or more mother stock nurseries amongst their members. These mother stock nurseries play an important role in the certification scheme because they provide the certified propagation materials, like budwood, cuttings, rootstocks or seeds that the other nurseries need to produce certified fruit tree saplings.

Each NGA should have its own technical officer to ensure that the certification scheme operates successfully.

2. The certification procedure

1. A registered nursery member of ANNGO can apply to register mother stock trees. The nursery will need to meet the eligibility criteria listed in the ANNGO fruit tree certification scheme (see Annex 2).

2. The application should be made at least one year before propagating material (e.g. budwood) is used from the tree. The nursery grower should provide details of the mother plants to be registered, a map of the mother plants and a brief plan of what he plans to do (e.g. collect budwood in year 201X).

3. Before registration of mother plants, the nursery will be inspected by the certification authority to ensure that they meet the require standards (see section 3 below). More than one inspection may be necessary.

4. If the mother plants meet the required standards they will be registered.

5. The mother stock nursery should request a registration book, the "mother stock nursery book" (see Annex 6), and labels for propagation materials (e.g. budwood) to be collected from the registered mother plants. The nursery book and the labels are only issued by the certification authority (fruit tree saplings can only be certified if they are budded with budwood that is correctly labelled and comes from registered mother plants).

6. The labels from propagation materials constitute the AANGO certification document that guarantees the trueness to type of the mother stock materials. A correct label contains the variety number of the mother tree, the name of the variety, the code of the nursery, and the date of collection (Figure 50):

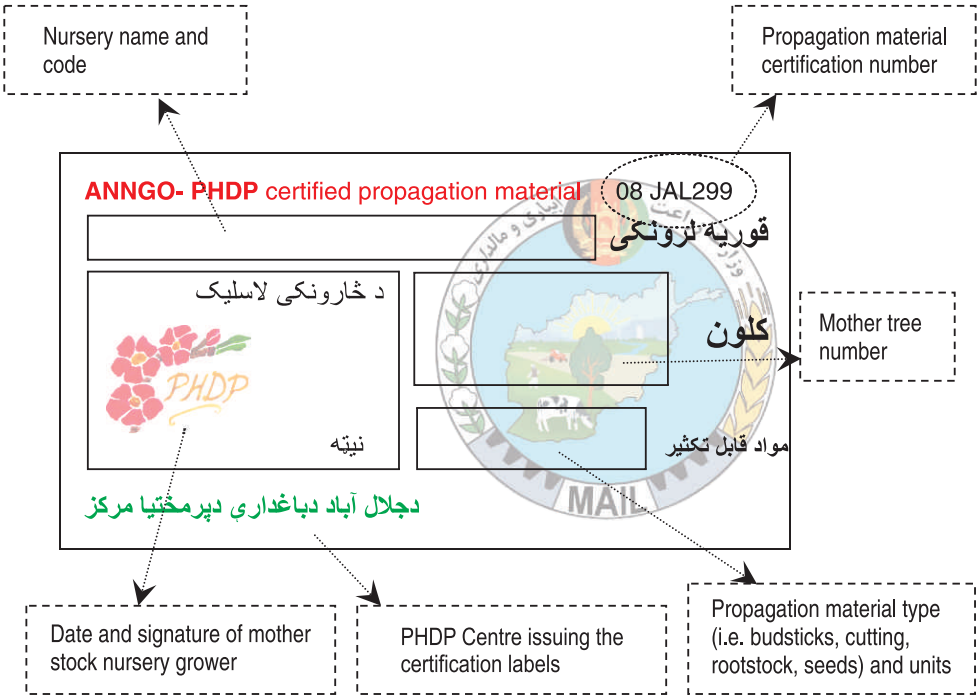


Figure 50: *Certification label for propagation materials under the provisional ANNGO-PHDP certification scheme*

7. Mother stock nurseries must record all disposal (e.g. sale or own use) of certified propagation materials (budwood or cuttings with certification labels) in the mother stock nursery book. This book must be available to the certification authority on request. The records should show the date of disposal, customer (nursery code), fruit species, variety (clone number), label number and quantity.

3. Standards for registered mother stock plants

1. Each planting location shall be subject to approval by PHDP and shall be in an area suitable for healthy growth with minimal risk of spread of infectious pests and diseases.

2. Water supply should be uncontaminated (recirculating water should not be used unless it has been efficiently decontaminated). Fields where drainage water from other fruit tree nurseries or orchards may enter should be avoided.

3. In order to reduce the risk of soil-borne infection, previous cropping should not have included fruit plants of the same genus during the past 2 years.

4. All registered mother stock plants shall be kept in a good growing conditions and pests shall be effectively managed. Suitable precautions shall be taken in cultivation, irrigation and in other farming practices to guard against spread of disease.

5. Materials and tools should be disinfected, and used only for the crop concerned. Secateurs should be disinfected between pruning trees of different clones.

6. There should be no off-types (but if off-types are found, they will have to be removed and another inspection arranged).

7. Mother plants shall have originated from registered clones maintained by PHDP or other sources approved by PHDP.

8. A mother plant may not be located within 5 meters of any non-registered plant of the same genus. Only registered plants are permitted in a registered block of mother plants. Mother plants may not be used for propagation purposes until trueness to type has been established.

9. There should be a gap of one plant between mother plants of different clones in the same row (i.e. if the trees are spaced 1.2 metres apart, then there should be a gap of 2.4 meters).

10. There should be a sign at the beginning of each variety/clone of mother plants showing the row number and clone number. Signs should also be used at the beginning of a new row.

11. Each mother plant shall bear a permanent number. Labelling of each registered mother tree shall be done in a manner approved by the certification authority.

12. All the mother plants should be recorded on a map showing their identity and location in terms of row numbers and relative positions within the rows, in accordance with their actual identity and position in the nursery.

13. Mother trees shall be planted and maintained in a manner, and at sufficient distance, that branches of different clones do not overlap.

14. There should be no weeds or intercrops growing within 1 meter of the mother trees. The ground in a mother tree block and for a distance of 5 meters surrounding it shall be kept either clean cultivated or in an approved, properly controlled, ground cover.

15. There may be no budding, grafting or top working on registered mother stock trees.

16. Flowers should be removed before they open.

4. Traceability

If the procedure and standards of the certification scheme are carefully followed by the mother stock nursery then it will be possible to trace the fruit tree saplings that a fruit grower buys back through the nursery system to the original source of the genetic material.

Figure 51: *Sample of label for certified accredited planting material, in this case apple budwood (E. Vernon)*

5. Record keeping

In this last part of the field training, you will emphasise the importance of maintaining two types of records:

1. Nursery management information

It is useful to keep a record of observations and treatments performed on the plants whilst growing in the mother stock nursery. These may include:

- weather condition observations
- growing behaviour of the plants
- pests and diseases
- any management treatments including input costs (materials and labour)

These records are useful to analyse the performance of the varieties for future considerations and to aid decision making for good business management.

2. Traceability information

The following documents should be retained:

(a) Records concerning the origin of the mother stock plants; the record document may be the certification label. In the case of imported materials, an invoice, packing list or delivery note, should be kept, as well.
(b) Map of the registered mother stock plants (see an example in Annex 7).
(c) Registration book of delivery of certified budwood and cuttings (Annex 6).

The most important advantages of a traceability system include:

- Ability to trace the origin of the germplasm and assure that the plant is true to type
- Easier quantification of production
- Assurance of production and management quality

Annex 1: List of surveyed species of importance for fruit production of Afghanistan (FAO, 2003)

Common name	Botanical name	Yearly production in Afghanistan (FAO estimates) (tn)
Grape	*Vitis vinifera*	520,000
Apricot	*Prunus armeniaca*	63,000
Pomegranate	*Punica granatum*	23,132
Almond	*Prunus dulcis*	16,079
Japanese plum European plum	*Prunus salicina;* *Prunus domestica*	6,608
Peach	*Prunus persica*	6,237
Apple	*Malus domestica*	6,117
Citrus	*Citrus* spp.	1,712
Cherry	*Prunus avium;* *Prunus cerasus*	No data available
Mulberry	*Morus alba;* *Morus nigra*	No data available
European pear	*Pyrus communis*	No data available
Persimmon	*Diospyros kaki;* *Diospyros lotus*	No data available

Annex 2: Checklist of Criteria for Eligibility to become Mother Stock Nurseries

CRITERIA	COMMENTS	Satisfactory? Yes	No
The nursery grower (or a member of his family) should be:			
❑ Literate.			
❑ Numerate.			
❑ Experienced in nursery growing (min. 5 years).			
❑ Skilled in budding or have staff with budding skills			
❑ Interested and willing to participate in training			
❑ Willing to follow industry standards			
❑ Willing to keep written records.			
❑ Willing to supply (i.e. sell) budwood from certified mother stock trees to other members of the association.			
❑ Having sufficient financial resources for purchasing essential inputs (such as fertilisers, manure, crop protection products, basic tools, labour, signage, etc).			
The nursery should look organised and well managed:			
❑ Good layout of plants in straight rows; access paths.			
❑ Separation of young saplings and mature orchard trees (not saplings growing between mature trees).			
❑ Plants look uniform and healthy.			
❑ No serious weed problems.			
❑ No pest or disease problems			
❑ No nutrient deficiency symptoms.			
❑ Plants adequately irrigated; no wilted plants.			
The location for planting mother trees:			
❑ Should not have been previously used in the last 2 years to grow fruit trees (saplings or mature trees).			
❑ No risk of flooding			
❑ Protected from livestock.			
❑ Irrigation water available all year round			
❑ Should be of sufficient area to accommodate the required number of Mother Stock Trees when planted at a spacing of 1.2 meters apart in rows 3 meters apart.			
❑ A distance of 5 meters should be allowed between the Mother Stock Trees and any other fruit trees or saplings			
❑ Additional land for expansion of the block of Mother Stock Trees is desirable.			

Annex 3: Information required to register mother stock nurseries

BASIC INFORMATION REQUIRED FOR REGISTERING MOTHER STOCK NURSERIES	
Nursery code Name of owner National ID number	
Settlement District Province	
Telephone number	
GPS co-ordinates of nursery	*LONG:* _____º_____' _____" *E* *LAT:* _____º_____' _____" *N*
Directions on how to reach the nursery	
Area of nursery (*jeribs*)	
Number of saplings sold in the previous year with breakdown by species.	
Expected number of saplings to be sold in the present year with breakdown by species.	

Annex 4: Calculation of Mother Stock Tree Requirements

Species	Variety	No. of Saplings Sold per Year	No. of Buds Required per Year for Own Nursery	No. of Buds Required per Year for Sale to Others	Extra 10% to Account for Losses	Total No. of Buds Required per Year	No. of Buds per Mother Stock Tree	No. of Mother Stock Trees Required	No. of Mother Stock Trees (Rounded Up)
Total									

Note that a yield of 250 buds per tree is assumed, but this yield may not be achieved until 3 or 4 years after planting the Mother Stock Trees. In this case, the nursery grower may not wish to sell buds to other nurseries until he has satisfied his own requirements.

Annex 5: Suggested agendas for association meeting

a. Preparatory Meeting with the Association	
9.00 am	Holy Qoran
9.05 am	Check data on annual sapling sales. Adjust for any missing data.
10.00 am	Tea break.
10.15 am	The ANNGO or Local Association programme for the distribution of saplings of Mother Stock Trees: ▪ Benefits for nurseries of improving the quality of saplings ▪ Improvement of sapling quality by using certified budwood from certified Mother Stock Trees ▪ The list of certified clones available and the selection process ▪ Mother stock trees and the assumed yield of buds ▪ Calculation of mother stock tree requirements ▪ Mother stock nurseries and the criteria for eligibility Plans for the visit to the PHDC and/or demonstration orchards
12.30 pm	Close meeting. Take lunch.

b. Meeting in the PHDP nursery to select clones	
9.00 am	Holy Qoran
9.05 am	Welcome and introduction (Germplasm Development Officer) ▪ Provide plan of nursery layout ▪ Provide list of clones with notes
9.15 am	Start inspection of clones ▪ Explanation of the list, clone numbers, row numbers, signs, labels. ▪ Inspection of the main clones and their key features
10.00 am	Tea break
10.15 am	Continue inspection of clones
11.00 am	Revise the tentative list of selected clones
11.55 am	Agree schedule and plan for the next meeting
12.00 am	Close meeting. Take lunch.

c. Meeting with the Association to Finalize the Selection of Clones, Numbers of Saplings and Mother Stock Nurseries	
9.00 am	Holy Qoran
9.05 am	Welcome and introduction to the meeting (Germplasm Development Officer)
9.15 am	Review of the list of clones and numbers of saplings required.
10.00 am	Tea break
10.15 am	Revise the list of nominated mother stock nurseries
10.45 am	Revise the list of clones and numbers of saplings per mother stock nursery.
11.45 am	Discuss any issues regarding the development of the association
12.10 am	Inform the association about plans for training.
12.00 am	Close meeting. Take lunch.

Annex 6: The Mother Stock nursery book

NURSERY GROWERS ASSOCATION	PHDC Centre

DISTRICT	VILLAGE	NURSERY GROWER CODE

Inspector signature	Date	Settlement	District	Nursery grower name	Nursery grower code	Nº of buds	Budwood variety/clone nº	Label nº (certification number)
	02/20/08	*Jaghare*	*Enjil*	*Herat Nursery Association CHA*	*HER001DO*	*350*	*405*	*08 HER001*
	02/20/08	*Jaghare*	*Enjil*	*Herat Nursery Association CHA*	*HER001DO*	*240*	*244*	*08HER001*

Note: This Nursery Book serves to register certified mother stock budwood collected from registered mother stock trees. Certified mother stock budwood is distributed to registered nursery growers for the production of certified saplings.

Annex 7: Application to register Mother Stock trees

ANNGO Fruit Tree Certification Scheme

To: Germplasm Development Officer
Perennial Horticulture Development Project,
Ministry of Agriculture and Irrigation,
Horticulture Building,
Jamal Mina, Kabul

Name of nursery owner _____

Nursery registration number _____

Nursery growers' association (if applicable) _____

Address _____

_____

_____

Telephone No. _____

Nursery location _____

_____

_____

The following documents must be attached to this application:
1. List of the plants to be registered (see form provided with this application)
2. Map of the nursery, marking where the different species and varieties/clones will be grown
3. Additional traceability documents (e.g. invoices, packing list or delivery note)

I understand and agree to abide by the conditions and standards of the ANNGO Fruit Tree Certification Scheme. In particular, I certify that to the best of my knowledge, none of the land planted or to be planted is infected with any plant diseases. I confirm that I shall take adequate steps to maintain the identity of plan

1. Details of plants to be registered

MAIL clone number (if available)	Species	Variety	Rootstock	Certificate number (label number) of mother trees	Certification authority	Number of plants to be registered

2. Nursery Map

Perennial Horticulture Development Project

Ministry of Agriculture, Irrigation and Livestock
Horticulture Building, Jamal Mina, Kabul, Afghanistan

Contact: Greg Cullen, Team Leader
afghanistanhorticulture@gmail.com
www.afghanistanhorticulture.org