Afghanistan Almond Nursery Manual

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For more information visit: International Programs ipresources.ucdavis.edu

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Almonds in bloom, Afghanistan & California (Photos: Driver & UCANR)

1. Manual Objectives

The objectives of this manual are to help those working in the Afghanistan Almond industry:

1. Understand why standards for trees and product are important in developing markets
2. Be able to identify and produce true-to-type trees
    a. Develop draft best practices for mother nursery/demonstration plots and grow out nurseries
    b. Develop draft extension materials

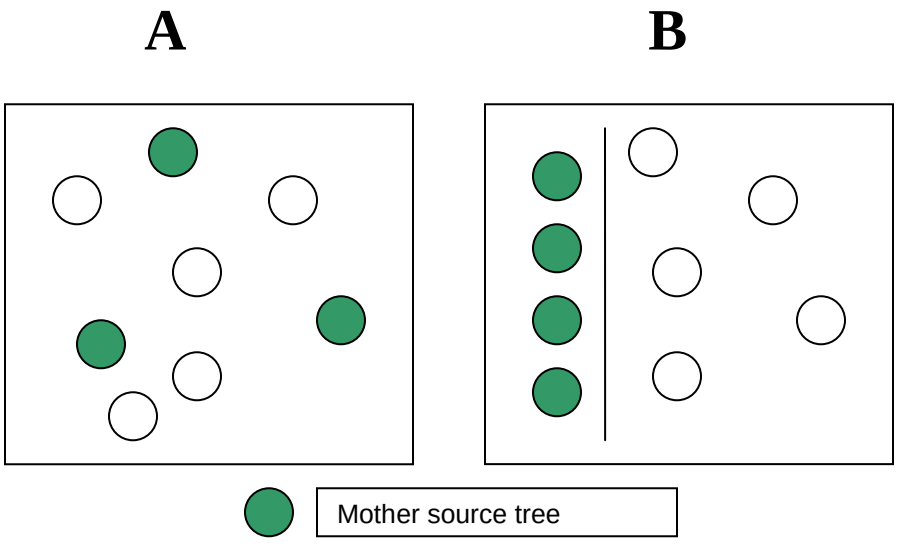
2. Overview of Program Priorities for Establishing an Effective Almond Nursery Management and "Certification" System in Afghanistan

Based on Roots of Peace experience and University of California, Davis (UC Davis) field surveys, an assessment was made of how to develop a "Certification" system for Almonds nurseries in Afghanistan. The following outlines the major steps of the program:

Goal: Produce true-to-type Almond trees

1. **Demonstration farm/mother block.** A joint demonstration farm/mother block should be established by the nurserymen. As a nursery, true-to-type trees will be planted and produced as part of a demonstration farm. Best Almond growing practices will be extended and the benefits of improved trees promoted.

    Nursery structure: In the long term, nurseries will move to a separate mother block nursery/demonstration farm - from nursery system A to B



2. **Mother nursery material.** Budwood for the demonstration farm/mother block will come from a single source (Perennial Horticulture Development Program - PHDP) for the following varieties:
    a. Satar Bayee
    b. Khairuddini
    c. Qahar bayee
    d. Qambary

    In addition, exotic material will be sought for:
    e. Non Pareil
    f. Carmel
    g. Butte
    h. Padre

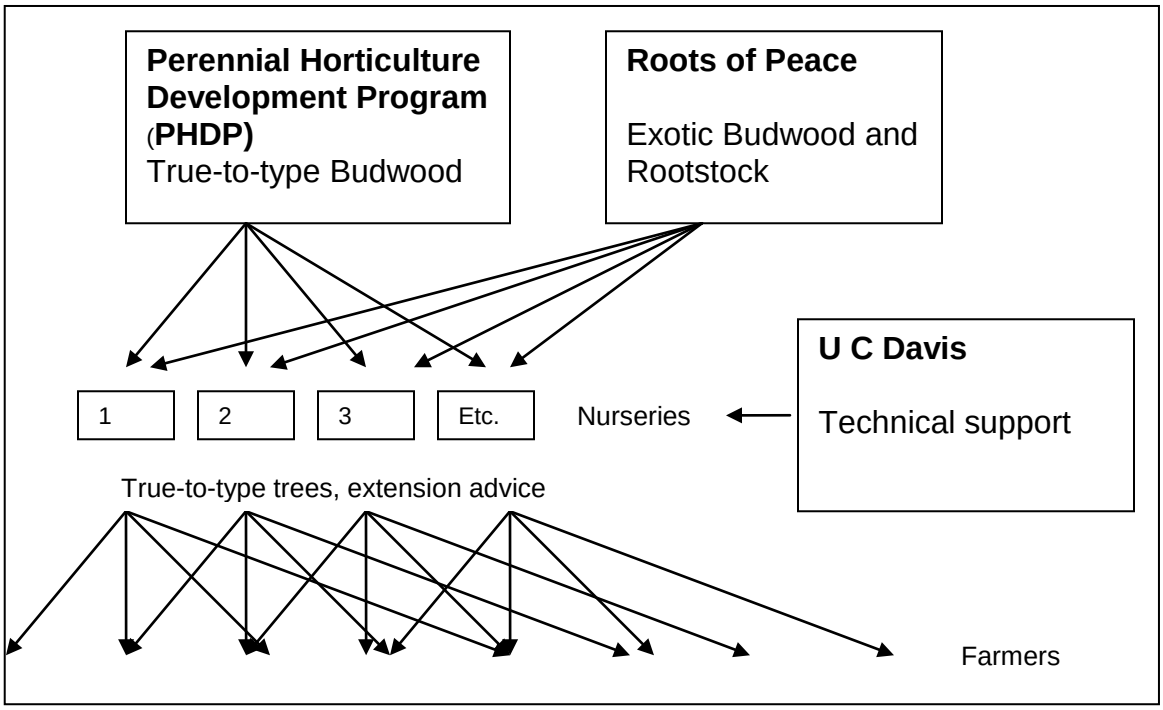


Figure: Schematic of budwood, true-to-type tree and extension information flow

3. **Rootstock.** Each nurseryman will establish their own seed tree for future rootstock production. Roots of Peace will provide either the seed or a true-to-type seedling or grafted seedling. One exotic seed tree (e.g., nemaguard) will also be considered.

4. **Viral disease indexing.** Over time a process of Disease testing (e.g., ELISA) will be introduced to spot check mother blocks. This will be done through Roots of Peace.

5. **Best Practices**. Best Practices will be developed by the Nurserymen in collaboration with Roots of Peace. This activity will be an on-going process supported by UC Davis developed extension materials and UC Davis training.

6. **Extension materials.** The lists below represent priorities identified to date.

    a. **Nursery extension material.** UC Davis in collaboration with local partners will develop materials for:
        i. Nutrition
        ii. Red spider – IPM and control options
        iii. Thrip control options
        iv. Rotation (3 year target)
        v. Irrigation – root death – defoliation – Shot-hole complex. Drain within 24 hours
        vi. Disease management
        vii. Weeds
        viii. Handling.
            1. Color coding before digging
            2. Budwood tagging
        ix. Digging – moving from shovel to mechanization. Principles of root development.

    b. **Production extension material.** Material will be developed for:
        i. Training and pruning
        ii. Orchard layout management
        iii. Pollination

Note: Given the time frame, this element of Almond work in Afghanistan will not be possible with new exotic trees. Nurserymen will produce and demonstrate true-to-type Almonds taken from existing and proven in-country (PHDP) germplasm. However, it is expected that in related activities, Roots of Peace will be working with nurserymen on exotic materials for future development and promotion.

Healthy true-to-type trees with improved management practices such as pruning will increase Almond production (Photos UC Davis IPM)

3. Almond Nursery Management

This section provides more detail on nursery management.

3.1 Benefits of True-to-Type Trees

True-to-type seedlings are identical to their parents giving the same quality fruit and having the same tolerances of diseases and pests. Such trees result in a more standard product which facilitates product handling, processing and marketing. Ultimately, industries based on true-to-type trees give greater returns to the producers.

Key point

True-to-type trees ultimately give greater returns to producers.

3.2 Establish Mother Nurseries as Demonstration Farms

Nurseries are to establish joint demonstration/ mother blocks. The nurseries are to establish their "Best Practices" so that the mother blocks can also be used both for extension of information to farmers as well as providing true-to-type materials.

Key points

Nurseries are to develop a set of "Best practices" for

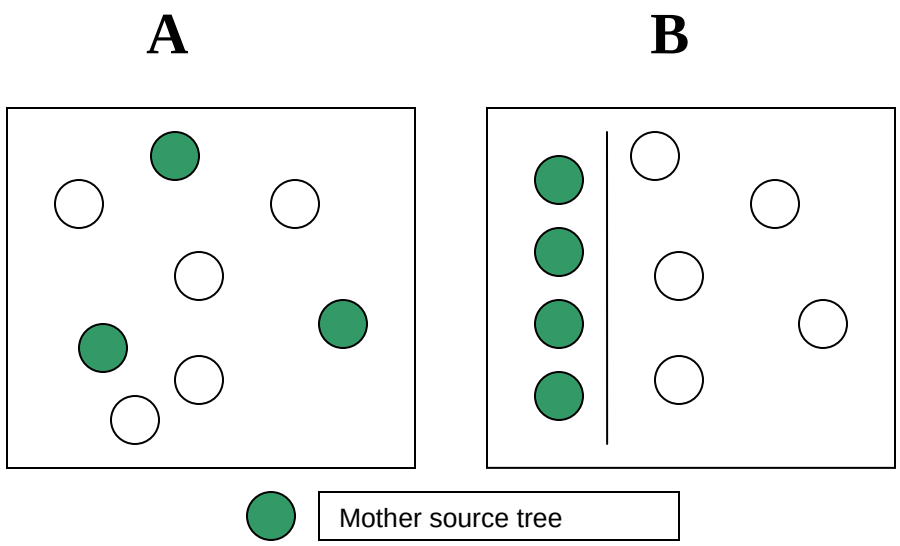
a. Mother nursery management,
b. Grow out nursery management,
c. Seedling product quality, and
d. Production practice extension materials for priority problems – including materials on the "benefits of true-to-type trees".

3.2.1 Budwood Source Material

Budwood for the demonstration farm/mother block will come from a single source (PHDP) for the following varieties:

a. Satar Bayee
b. Khairuddini
c. Qahar bayee
d. Qambary

The nurserymen will move from the present system (A) where mother trees are spread across a range of locations to developing a separate mother block nursery/demonstration farm (B) – see figure.



Coinciding with these early developments, it is expected that Roots of Peace will be introducing new “exotic” rootstock materials (e.g., Nemaguard) and exotic budwood such as:

a. Non Pareil
b. Carmel
c. Butte
d. Padre

for comparison and demonstration purposes (See following figure).

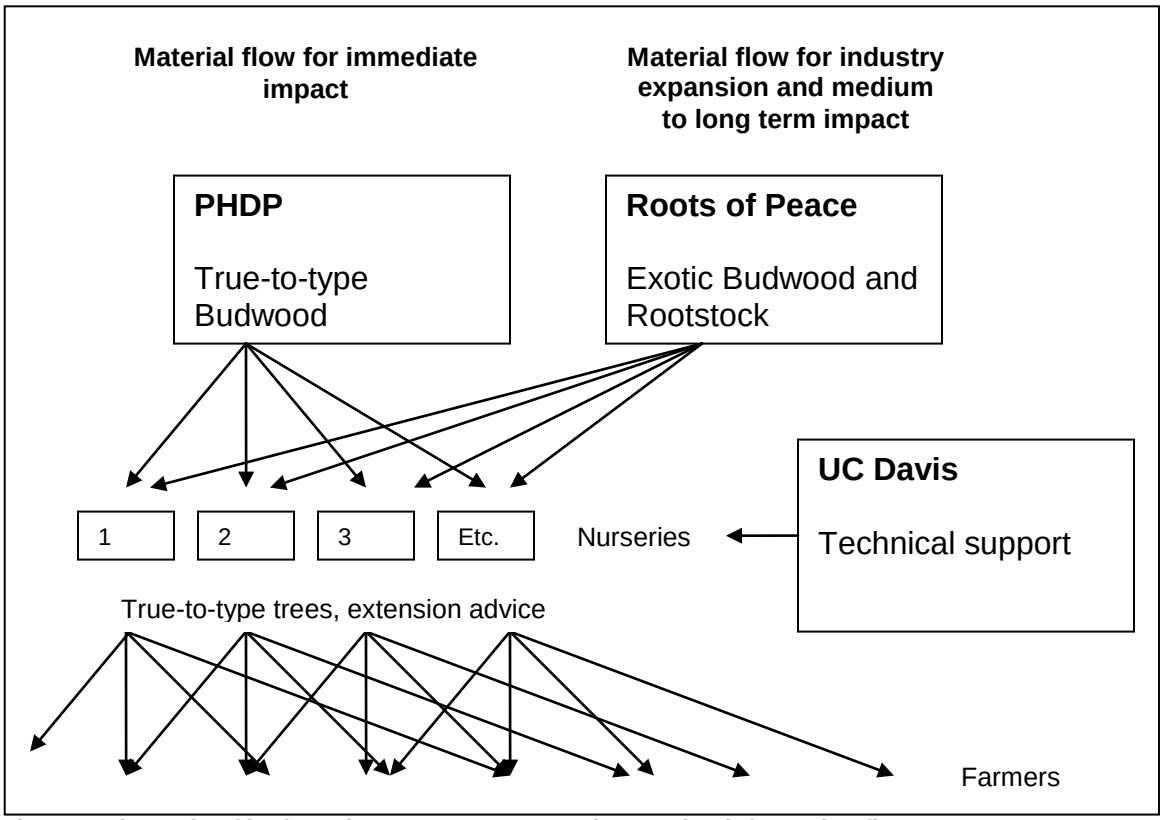


Figure: Schematic of budwood, true-to-type tree and extension information flow

Key points

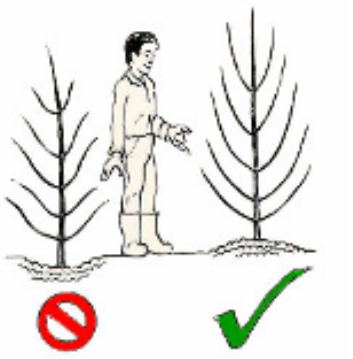
1. Budwood for the demonstration farm/mother block will come from a single source (PHDP)
2. Nurseries will develop a centrally located mother nursery which will also be used as a production demonstration block.

3.2.2 Site Selection, Site Security and Site Preparation

Almonds do best with full sun and in well-drained loam-textured soils that are at least 1-2 meters deep. Fertile sandy loam soils are best. Avoid growing Almonds in very sandy or shallow soils. Almonds produce well in areas with adequate chilling (400 to 500 hours below 7° C). As Almonds bloom early, avoid planting where late spring frost occurs.

Soil problems such as compaction, plow pans, reduce tree development and productivity. These possible problems must be diagnosed and eliminated before the trees are planted in an orchard. If a site has shallow soil due to a hardpan, try to break through the hardpan when preparing the site.

Avoid planting in low spots or in areas that flood frequently.



Trees must have good drainage

Plant trees at least 5-6 m apart to reduce the probability of poor growth due to competition.

When planting, allow for any settling of the soil which can result in the tree being in a hollow (as in the above picture on the left). Thus, plant the tree slightly high allowing for the tree and soil to settle. Alternately, you may wish to dig a hole and apply animal manure, etc.. Backfill the hole and place a stick in the middle of the hole. Allow 2-3 weeks for the soil to settle and then plant the tree.

Key point

Almonds require good drainage. Avoid planting in low poorly drained spots.

3.2.3 Identification, Mapping and Record Maintenance of Individual Varieties Within the Mother Block

As the new nurseries are established, all nurseries trees must be clearly marked and records must be kept

indicating genetic sources with a map to indicate tree location.

Specifically, nurseries should clearly identify source trees used for rootstock seed and budwood with two forms of physical identification (such as tree staking, tree branding and/or attaching a tag). In addition, nurseries will maintain a plot map indicating source trees and their specific varietal names.

Key point

Clearly mark budwood trees and keep a map showing budwood tree type and location

3.2.4 Rootstock

Bitter Almond – of non-select parentage and unknown history bought in bazaars – is presently the primary source of rootstock. Each nurseryman is to establish their own seed tree for future use as rootstock. Roots of Peace will work with Nurserymen to identify appropriate seed or a mother source for bitter Almond.

Roots of Peace will provide either the seed or a true-to-type seedling or grafted seedling. One exotic seed tree for each nursery will also be considered. UCD will work with Roots of Peace to identify such possible new rootstock (e.g., nemaguard) to lay the groundwork for possible future diversification of rootstock material.

Key point

Each nursery is to establish its own seed bitter Almond tree for rootstock.

3.2.5 Viral Disease Indexing

Maintaining healthy and disease free nurseries is a major goal of any best practices/certification system. UCD will recommend to Roots of Peace appropriate Elisa or other testing kits and provide training to introduce a system of spot checking for the mother blocks and demonstration nurseries. Roots of Peace will lead this initiative.

Key point

Over time, nurseries will need to establish procedures to show they are disease free.

3.2.6 Identification and Transportation Procedures for Outgoing Plant Materials

Budwood is to be bundled and tagged at the time of collection to help reduce mistakes in subsequent tree identification. Product saplings are to be marked by variety with color according to agreed industry-wide codes.

Clear labeled and documented trees, budwood and nursery trees is essential (photos IPO, UCD)

Key point

Nurserymen must develop an agreed color coding system for easy identification of budwood bundles

3.2.7 Sanitation Practices

Sanitation is the best tool to prevent the introduction and spread of pests and diseases into orchards. In particular, perennial weeds, nematodes, and some diseases can be difficult to control once trees are established.

Steps to take

- Prevent the introduction or spread of infestations by removing and immediately burning infected limbs and fruit.
- Disinfect cutting tools periodically during pruning and at any time that they come into direct contact with diseased tissue.
- Clean equipment used in other areas to avoid introducing pathogens, nematodes, or weeds.
- Remove stumps, brush piles, and debris which can harbor diseases as well as vertebrates and insects.
- Remove roosting, nesting, or resting areas that may attract large numbers of crop-destroying birds.
- Keep the area about the tree crown free of weeds to reduce crown rot infections.
- Spot-treat or remove perennial weeds to prevent their spread.

Key point

Each nursery is to establish its own priority sanitation practices.

3.2.8 Management and Extension Material

True-to-type trees will be produced and the joint mother nursery/demonstration farm can be used to demonstrate best Almond growing practices and to highlight the benefits of improved trees.

Extension materials need to be developed to support grow-out nursery management and production. Priorities for commercial production support should be to develop materials for:

- Pruning (priority)

- Pollination (priority)

Pruning and Training

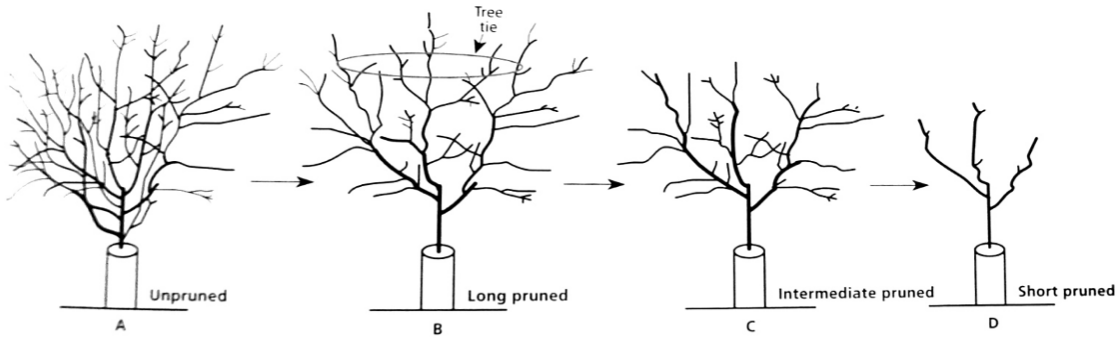
Note: Pruning is increasingly the same for nursery (budwood) and production trees. This section includes:

1. Pruning overview.
2. Pruning at planting
3. First year pruning
4. Second pruning
5. Third pruning, and pruning each season thereafter
6. Does pruning increase yields?
7. Mature tree pruning

Pruning Overview

Prune young orchard trees to develop a tree structure that develops limbs to support a heavy nut load. Trees are trained to develop a sturdy tree and a canopy that can support large quantities of high quality nuts. Training is done during the first 1 to 5 years after planting and should be completed before commercial quantities of nuts are set.

Almonds are usually trained to a vase or modified vase system where the center is open and has 3 or 4 main scaffolds with no central leader (See figure below). Remember that exposed limbs on young trees easily sunburn. Protect exposed limbs with a 50:50 mix of white non-toxic interior latex paint and water or whitewash.



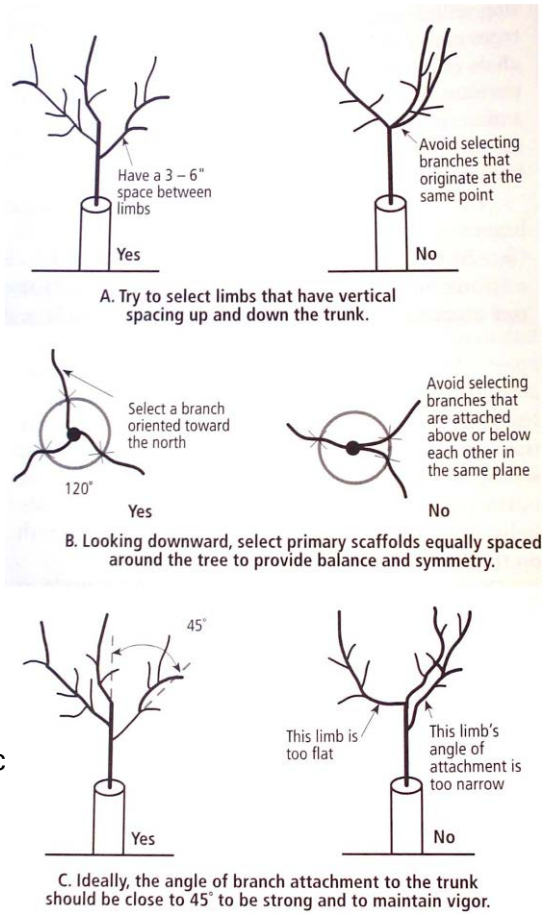
Pruning is best done during the dormant season. This period is also the best time to prune out diseased wood, crossing limbs, or narrow crotch angles. Pruning can also be done during the summer to control vigorous shoot growth.

The main purpose of pruning is to manage light penetration into the crop canopy. In young trees, light needs to reach down to the main scaffolds to stimulate the creation of fruiting positions on secondary shoot growth. In older trees, light penetration maintains productive wood in the lower half of the tree.

Achieve light penetration by thinning cuts. Eliminate crossing-over and parallel limbs. Keep the inside of the tree reasonably open by eliminating water sprouts and limbs growing through the center.

Do not eliminate lower limbs and leave the upper (possibly problematic) limbs. Such pruning eliminates productive limbs and forces the tree to grow higher. Evaluate your pruning by the amount of sky visible through the tree's canopy.

Training and pruning almond trees is considered an art and a science by many growers. The art is the pleasant tree shape created by the skills of the pruner and the science is the tree responds to pruning. Both art and science interrelate to each other. To create a well formed tree the pruner needs to understand tree responses to a given pruning cut. In addition, the pruner needs to understand that the purpose of pruning is to train a young tree to a permanent framework which will optimize a bearing surface as soon as possible. Furthermore, the pruner needs to understand that it is counterproductive to be fighting the tree's natural growth habit. There are basic principals and guidelines that apply to the formulation of almond trees. Some will be discussed in this article but as a summary review “What is pruning?” Pruning is the removal of unwanted growth (shoots, limbs and branches) and consequently the removal of leaf surface whic dwarfs tree development.



Pruning at Planting

The first pruning is done soon after the trees are planted; their tops are cut at 105 cm (about 42 inches) from the ground, and will provide more room for primary scaffold selection in the first dormant season.
When the new shoots have grown four to six inches during the March – April period (in latitude areas similar to California), eliminate all of them below eight inches from the top. This is to say, the top eight inches will retain its shoots. Examine these shoots and where there are twins, eliminate the weaker one. The elimination of unwanted shoots early in the season will not decrease tree development due to reduced leaf surface.

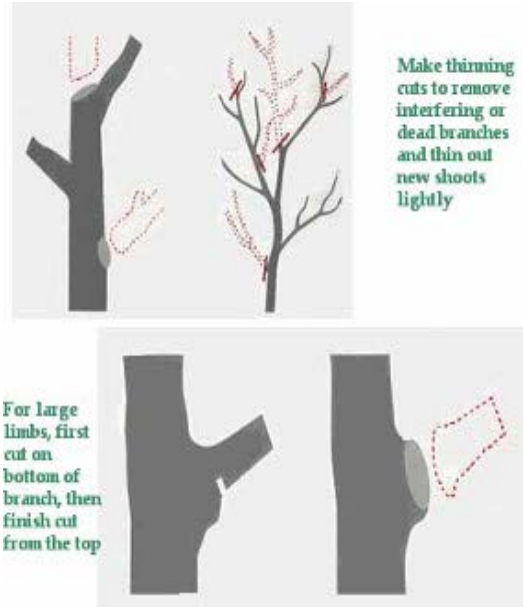
First-Year Pruning

The primary scaffold selection is done after the first growing season. At this time upright branches with wide angles should be selected because they are stronger than branches with narrow angles. The recommended number of primary scaffolds is three or four. In some orchards however, up to seven primary scaffolds have been selected without any problems. If multiple primary scaffolds are selected, they should be distributed up — down and around the trunk. All horizontal and narrow angle limbs should be eliminated. The elimination of these limbs will create more space for the selected limbs.
After the pruning is done, the tree canopy should be well balanced without open spaces. Then, its main scaffolds may be headed –if needed - to achieve more vigor.
The heading of scaffolds can be done in the winter but at this time pruning cuts invigorate limbs. The best time to do a heading cut is when the apical bud begins to leaf out. At this time, heading cuts promote lateral shoot growth. A heading cut is done to eliminate the short lateral growth on the top of the scaffolds. Also, it is done to have all the limbs at the same height.

Almonds usually have more flowers than they can support. As a result, they normally drop many of the flowers and small fruit early in the season. There is no need to hand thin fruit.

Second Pruning

After the second growing season, the second dormant pruning is done. Low limbs that may interfere with herbicide sprays or mini-sprinkler irrigation should be eliminated. The center of the tree should be kept moderately open to allow light penetration inside the tree. This is done by eliminating limbs and vigorous shoots growing through the center. Secondary limbs with narrow angles should be eliminated at this pruning. Once the pruning is done, the trees should be tied with a flat rope. This tie should be placed 24 inches below the top of the tree. This tying keeps the tree upright thus avoiding the umbrella shaped trees. The tying should be done in the winter. Once the tree begins to grow and fruit set has taken place, it is very difficult to tie trees.



Third Pruning and Pruning Each Season Thereafter

The third dormant pruning is done after the third growing season. This pruning consists of removing limbs that are crossing (e.g., limbs from the north side of the tree growing towards the south). The purpose of this pruning is to keep the south side of the trees upright and the north side growing towards the north.

Restricting the pruning to minimum, in the second and third year, minimizes the number of water sprouts produced in the third and fourth year. Therefore, to eliminate the need to prune off water sprouts in the fourth year, the pruning must be kept to a minimum. Most varieties require tying beyond the fourth year, as needed.

Does Pruning Increase Yields?

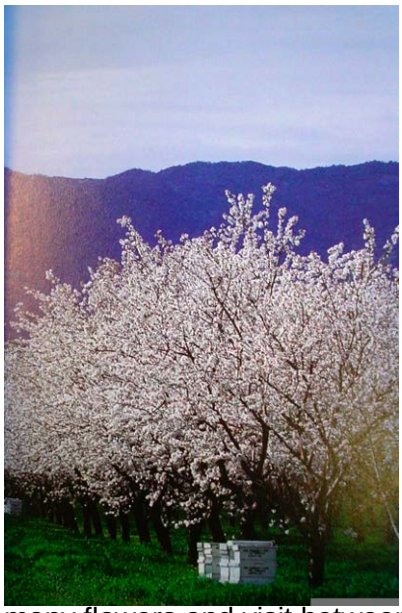
Pruning doesn't increase yields in young or mature orchards. In fact, when young trees are pruned too much, the yields go down. This effect has been demonstrated in experiments conducted in Kern County. Therefore, the reason for pruning is not related to yield increases but it is related to other management practices. The reason to prune a mature orchard should be based on insect management practices, market strategies and sanitation practices.

When mature almond orchards get to be higher than 20 feet, it is very difficult to remove all the mummy nuts in the winter. If a grower is having high reject levels from a mature orchard whose trees are higher than 20 feet, he needs to lower the tree height using a tower pruner. Pruning is also necessary when the crop is not drying on the orchard floor due to lack of sunlight. A prolonged drying period on the orchard floor can result in high ant damage.

The in-shell market doesn't allow hull-tights (stick-tights). Therefore, to have more than 90 percent of the nuts completely open, the sun must penetrate well throughout the tree canopy. This is accomplished by having the trees well pruned.

Pruning is also justified when there is the need to remove broken branches or branches that have died due to Ceratocystis Canker.

Pollination



Pollination is critical to the production of almonds. Because the almond tree is not totally self-fertile, bees are brought to the orchard to carry pollen between alternating rows of almond varieties. The honey bee is practically the only pollinating insect of economic importance on almonds. A heavy honey bee population is required to force bees to visit many different trees.

Bees need warm, sunny and calm conditions for optimal pollination. Stormy, cold weather during the bloom stage can limit bee flight and reduce the size of the crop.

Bees must carry pollen from a flower of one cultivar to another receptive flower to contribute to fruit-set. To obtain a maximum crop of almonds, essentially 100 percent of the flowers must be cross-pollinated. The bee population should therefore be sufficiently heavy that repeated visits to every flower occur. Bees must visit many flowers and visit between cultivars to ensure the pollen is spread from one tree to another to the maximum extent.

Pollination Recommendations and Practices

One pollenizer row of trees is suggested for every three rows of the main variety, or two rows of pollenizer trees for each two rows of the main variety. Four to six strong colonies of honey bees are needed per hectare.

The colonies should be distributed within the orchard in small groups 150 m (about one-tenth mile) apart. Each colony should have at least 5,000 cm^2 (800 in^2) of brood and a cluster of bees that covers most of the frames in a two-story deep-frame hive. The colonies should be in the orchard at the beginning of flowering and should remain until flowering on the main cultivar has ended.

The use of pesticides in adjacent fields must be considered in terms of their negative effects on the bees.

Other Orchard Management Considerations

Planting

The ideal planting time for fruit or nut trees is during the dormancy bare-root stage in winter or early spring. Plant as soon as possible after receiving trees from the nursery, and do not let trees dry out. The roots are very sensitive and must be kept damp and protected from high temperatures. Pack roots in peat moss, non-toxic root shavings or similar material and keep plants in cool, shady locations until ready to plant.

Avoid planting in a hole or a low-lying area to prevent diseases such as root rot. Where drainage is poor, plant trees in raised beds, or on ridges or mounds of soil several cm high and a m or so across. Plants will settle as added organic matter in the soil decomposes. The hole should be about 0.5-0.75 m wide and about 0.5 m deep.

When planting, remove the packing from the root system and examine the roots. Remove broken or decayed roots before planting. Soak the roots in cool water for about 6 to 12 hours. After soaking, place the tree in the hole, carefully spreading out the roots and making sure the roots are all in their natural position. Avoid curling roots around the planting hole. Refill the hole with the original soil from the site and avoid adding organic amendments and fertilizers. While refilling the hole, pack soil around the roots to avoid air pockets. Leave the graft union 2 inches above the soil line. Water in after planting. Fertilizer is not usually necessary the first year.

Irrigation

Almonds require consistent, uniform soil moisture. In particular, water is very important for young trees during the first year when the root system is developing. Any stress during early growth or during fruit production will reduce yields and fruit quality and may make trees more susceptible to boring insects or diseases. Moisture should be replaced well before the trees begin to show stress. Young trees may need up to 12 l – 19 l of water per week. Frequent light watering creates a shallow root system. Sandy soils may have to be watered every 3 to 5 days; heavier soils may need only to be watered every 1.5 to 2 weeks. During hot weather, young trees may need to be watered more often. Avoid prolonged saturation. If weather is windy, be sure to stake young trees, otherwise they will lean in wet soils.

Do not water established trees near the trunk and lower branches, as this promotes root and crown disease. Water plants when needed around the drip line (outer diameter of the tree canopy) and beyond. Try to water deeply and infrequently (every 2 to 3 weeks) by irrigating for 12 to 24 hours to wet to a 1- to 2-m depth. Reduce water in late summer and fall.

Nutrition

Maintaining a good fertilization program keeps your plants vigorous and helps prevent diseases such as bacterial canker and oak root fungus.

Nitrogen

Nitrogen renews and invigorate fruiting wood. Young trees benefit from light applications of nitrogen fertilizer. Apply about 0.15 kg of ammonium sulfate (which equals 32 g nitrogen) per tree per year. **Note**: Ammonium sulfate is 21% N (or about one fifth Nitrogen). Place the fertilizer at least 45 cm from the trunk and water well after application. As trees mature, fertilizer can be increased up to 2 kg of ammonium sulfate (0.4 kg nitrogen) per tree per year. The best time to apply nitrogen is just after bloom.

Do not use more nitrogen than necessary. Too much nitrogen favors leaf growth, which can encourage insects such as aphids to build up. Ensure plant nutrition is balanced. In particular, look for symptoms such as iron or potassium deficiency.

Principles of N application:

- Apply N when leaves are present and tree roots are active.
- Apply irrigation to carry the N into but not past the root zone.
- For young fruit trees, apply multiple applications of N throughout the growing season.
- For mature trees apply part (**1/3rd**) of the N in late summer to provide the tree with N for early spring growth. The rest of the N should be applied during the spring.

Spraying

Pests: The main pests of Almonds are peach twig borer, oriental fruit moth, and navel orange worm. Spraying a pyrethriod as dormant spray is most effective with a dormant oil, which also smothers eggs. Alone it is OK, but not always effective on eggs. The strategy for dormant sprays is to reduce populations so that they start from a much smaller base in the spring and then can do less overall damage.

For disease: "The main almond diseases are because of spring rains during bloom and during the time of nut growth. No rain, no problem. But all treatments are preventative. Brown rot must be covered during pink bud stage. Shot hole is a problem with young developing leaves. Then after this we may have problems with scab or bacterial blast. These are diseases of wet weather during the particular stage of development. For treatment we apply preventively a range of fungicides for prevention. We watch the weather and apply only at risk. However we always apply one spray at petal fall, and almost always two weeks later." (Comments from University of California Almond Specialist)

Apply insecticide (Supertop) with an oil and with some fungicide to control over-wintering fungus and bacterial spores. Apply the mix when the trees are dormant especially after leaf fall. Follow the manufacturer recommended rates and safety practices.

Priority Production Practices for Nurseries as Demonstration Plots

The following have been identified as priorities for production extension materials for production trees.

1. Training and pruning
2. Orchard layout management
3. Pollination

Key points

1. Priority production problems include
a. Training and pruning
b. Orchard layout management
c. Pollination
2. Extension materials have been developed for priorities.

3.3 Grow Out Nursery

3.3.1 Nursery Site Selection and Site Preparation

In general site selection for nurseries in Afghanistan seems okay. Soils on selected sites are often a little heavy, but nurserymen often have limited options. Almond nurseries are often part of a larger mixed nursery.

To the extent possible, nurserymen should

1. Maintain a three year rotation of land between nursery crops. Use crops such as wheat and barley for the intervening periods.
2. Locate nurseries close to the mother blocks/demonstration farms.
3. Level sites
4. Ensure sites have good drainage

There is a general lack of tractors and equipment for proper site selection. Fields are often uneven which contributes to fields being small and subsequent issues related to irrigation (over watering and lack of water uniformity).

Key points

1. Ensure good site drainage
2. Aim for a three year rotation.

3.3.2 Nursery Management

Budding

Most budding by nurseries is presently satisfactory. There are different budding dates between nurseries, but this does not constitute a problem. Most nurseries practice “T” budding.

Budwood needs to be bundled and tagged at the time of collection from the mother trees to ensure that subsequent trees are correctly identified.

Nursery Layout

Double row raised bed. This system leads to higher numbers of trees and facilitates easier digging. Trees produced on a double row versus a single row will be smaller. For the present state of the industry this practice suffices.

Plant Nutrition

Plant nutritional practices vary and are primarily based on the presence or absence of any visual deficiency systems. There is minimal nutritional knowledge and a general need for the development of extension materials for plant, orchard and nursery nutrition.

Pests

Red Spider mites are the largest problem (implying dust is a problem). There is concern that treatment of surrounding fields (especially cotton) limits predators and so increases the problem of mites.

Thrips cause branching as they destroy the growing point. Thrips seem to be an isolated problem.

Irrigation and Disease

Irrigation (overwatering), leaf drop and shot hole are interrelated problems.

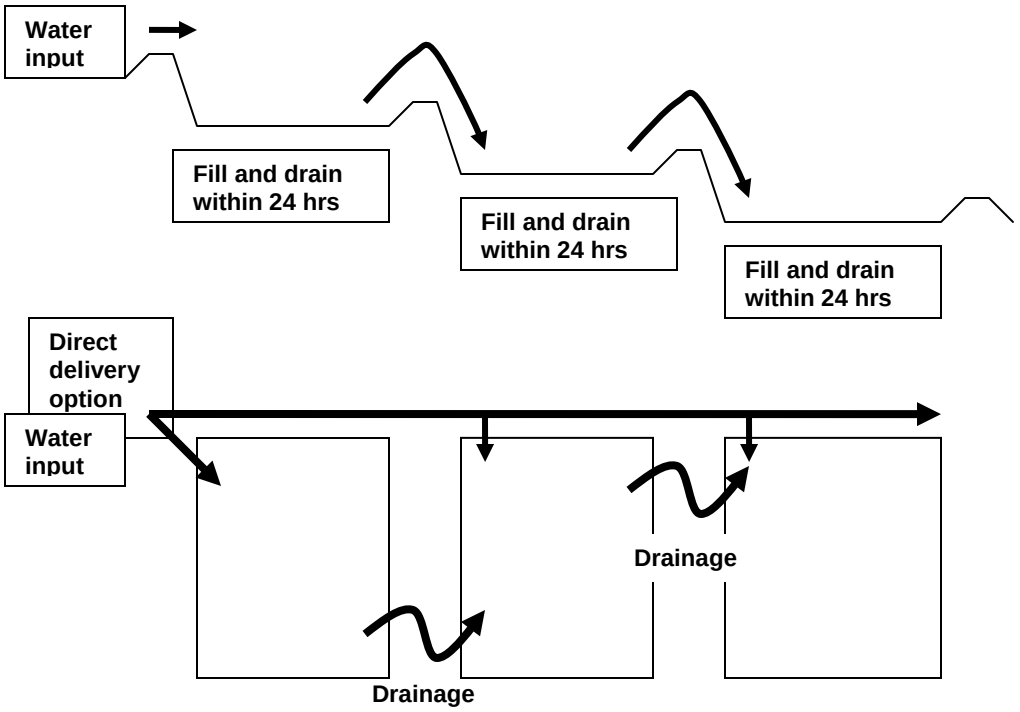
In general, the overwatering of fields kills the young developing tree roots. When water stress or increased heat (August/September) occurs, the young plants drop their leaves because of their reduced root systems. When humidity rises, these weakened plants are then more susceptible to shot hole.

The major recommendation is that there should be no standing water in the nursery 24 hours after the start of irrigation.

Extension material is needed to highlight the improved irrigation and drainage practices required.

There should be no standing water in the nursery 24 hours after the start of irrigation.

The following figure shows a **possible** field arrangement to increase water use efficiency and to improve field drainage and so reduce problems associated with waterlogging.



Weeds

Weeds reduce tree vigor and affect tree quality. There is a need for farmers to be aware of the general effects of weeds on plant growth and tree quality. Part of the problem is that weeds are sometimes used as animal fodder and so they are left to grow around the nurseries.

Weeds around trees can harbor pests, promote crown diseases, and compete for water and nutrients.

Control options could include hoe, herbicides or as used in other countries feeder geese or ducks.

Disease Viral Indexing

Maintaining healthy and disease free nurseries is a major goal of any best practices/certification system. UCD will recommend to Roots of Peace appropriate Elisa or other testing kits and provide training to introduce a system of spot checking for the mother blocks and demonstration nurseries. Roots of Peace will lead this initiative.

Summary of Needed Nursery Management Standard Practices

The key production nursery practices are:

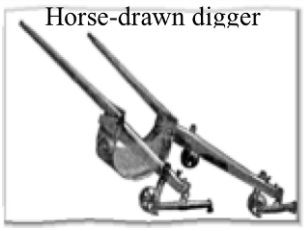
a. Nutrition
b. Red spider – IPM and control options
c. Thrip control options
d. Rotation (3 year target)

e. Irrigation – root death – defoliation – Shot-hole complex. Drain within 24 hours
f. Weeds
g. Handling.
    i. Color coding before digging
    ii. Budwood tagging
h. Digging – moving from shovel to mechanization. Principles of root development.

Key points

1. Identify priority grow out nursery practices
2. Develop standard practices for priority practices.

3.3.3 Tree Digging and Handling



Trees are mostly dug by shovel. There is some concern that this system is leading to excessive root pruning. A move to a mechanized or semi-mechanized system could be considered.

A color coding system – consistent across the industry - needs to be developed for identifying freshly dug trees.

Trees are sold mostly at digging with some sales 1-2 months before digging. Tree prices were found to range from $1.00 to $1.50 each.

Key points

1. Develop an agreed color coding system
2. Limit root pruning at digging

3.3.4 Quality (standards) (e.g., buds, seed size)

Elements that should be considered in developing quality standards include:

- Proper sanitation practices
- Screening and Isolation of incoming plant materials
- Methodologies in developing and maintaining “clean” plant materials
- Sampling and indexing protocols to support “clean” plant materials

Key points

Nurseries are to develop a list of target quality standards for seedlings and seedling production covering

2. Tree size
3. Sanitation
4. Handling, etc.

3.4 Record Keeping

Primary objective: Maintain adequate records to be able track and produce materials of known quality and origin.

Nurseries should build in redundancy by having all mother trees clearly marked (by two means – such as clear staking, marking on the tree and/or by a tag attached) and by having an official nursery note book that codes trees and shows their location on an orchard map.

Records should be kept on all product trees stating

- the source of Budwood
- the source of Rootstock
- Growing location (indicating which nursery and where on a map), and
- Growing conditions.

Key points

Records should be kept on all product trees stating

- the source of Budwood
- the source of Rootstock
- Growing location (indicating which nursery and where on a map), and
- Growing conditions.

3.5 Resources

Major reference: Statewide IPM Program, 2006. Agriculture and Natural Resources, University of California http://www.ipm.ucdavis.edu/index.html

USA Almond Board
http://www.almondboard.com/index.cfm

http://www.almondboard.com/landingPage.cfm?mnItemNumber=442

4. Glossary

Term	Meaning
Adventitious bud	Latent or dormant bud on a stem or root.
Annual	A plant that completes its life cycle (from seed to seed) within a single growing season.
Apex	The tip of a stem.
Apical bud	The bud at the tip of a stem.
Apical dominance	Controlling influence of the apical bud over the growth of a stem, which restricts the development of lateral buds. If the tip is removed apical dominance is broken, and lateral shoots below will grow more vigorously, competing to become the new leader.
Bark	The surface layer of the trunk and branches of woody plants.
Bud	A condensed shoot containing an embryonic leaf, leaf cluster, or flower.
Central leader	The central, usually upright, stem of a plant.
Chlorosis	A symptom of disease or disorder in plants in which a plant or part of a plant is light green or greenish-yellow because of poor chlorophyll development.
Crown	The branched part of a tree above the trunk.
Cultivar	A distinct plant variation that has originated in cultivation, not in the wild.
Defoliation	Loss of leaves.
Dieback	The death of tips of shoots caused by damage or disease.
Dormancy	The state of temporary cessation of growth in plants during winter.
Flower bud	A bud from which a flower develops.
Lateral bud	Bud that will form a side-shoot.
Leader	The main, usually central, stem of a plant.
Leaf scar	Point on a stem where a leaf was attached.
Limb	A branch of a tree
Mulch	A material applied in a layer to soil surface to suppress weeds, conserve temperature and maintain a cool, even root temperature.
Mummy nuts	Nuts that remain on the tree after harvest
Node	The point on a stem from which leaves, shoots or flowers arise.
Opposite	Buds, leaves and stems occurring in pairs at node.
Pathogens	Micro-organisms that cause disease.
Perennial	A plant that normally lives more than two growing seasons and, after an initial period, produces flowers annually
Petiole	The stalk of a leaf which attaches to the stem.
pH	The reciprocal of the hydrogen ion concentration of a medium. A value on a scale of 0 to 14 gives a measure of the acidity or alkalinity of a medium; pH values of 0 to 6.5 indicate acidic conditions, a pH value of 7.0 is neutral and pH values greater than 7.0 are alkaline.
Photosynthesis	The production of organic compounds required for growth in plants by complex process involving chlorophyll, light energy, carbon dioxide and water.
Pruning	Removing growth from a plant or tree to maintain its health, regulate its shape and control flowering.

Term	Meaning
Renewal pruning	A system in which older wood is regularly removed in favor of younger growth.
Root pruning	The removal of part of the root system of a tree to restrict growth and induce fruiting.
Scaffold branches	The main framework branches on a tree.
Scion	Plant, usually a desirable cultivar, that is grafted onto the rootstock of another plant.
Self-fertile	A plant that produces viable seed when fertilized with its own pollen.
Sucker	A shoot that arises at or below ground level from a plant's root or underground stem.
Terminal	At the tip of a stem or branch.
Thinning	The removal of a proportion of shoots to improve the vigor and quality of the remainder.
Transpiration	Loss of water by evaporation from the leaves and stems of plants.
Tree	A woody, perennial plant usually with a well-defined trunk.
Vegetative growth	Non-flowering, usually leafy growth.

Appendix 1. Draft List of Extension Material to be Developed

While other topics may emerge as needed, the initial topics to be developed as extension materials for field testing and use in training were tentatively identified as:

1. **Grow-out nursery extension material**
    a. Rotation (3 year target)
    b. Irrigation – root death – defoliation – Shot-hole complex. Drain within 24 hours
    c. Nutrition
    d. Red spider – IPM and control options
    e. Thrip control options
    f. Weeds
    g. Handling.
        i. Color coding before digging
        ii. Budwood tagging
    h. Digging – moving from shovel to mechanization. Principles of root development.

2. **Production extension material.**
    a. Training and pruning
    b. Orchard layout management
    c. Pollination

Fact sheet structure

Extension materials can be developed in the form of single or 2 page fact sheets. The possible structure is:

- Title
- What is the “topic”,
- Why is it important and when does “it” happen
- How do you manage the topic and what are the expected results

Fact sheets should include logos and who to contact for more information.

Appendix 2. Framework for Afghan Nursery Best Practices (Certification Standards)

Standards or best practices will be set by the Nurserymen in collaboration with PHDP, Ministry of Agriculture, Irrigation and Livestock (MAIL) and Roots of Peace. This activity will be an on-going process supported by and UC Davis generated extension materials, the example certification system (as a reference) and through training in-country and at UC Davis. Best practices content will be determined by the Nurserymen, but should aim to cover:

1. Mother nursery source material

A. Chain of custody – ensure that material can be tracked (may include: mother trees that are identified and which can be verified (tagging, records and maps).

2. Demonstration orchard and mother nursery

While all practices are important, it is considered that the priorities for industry improvement will involve establishing standard practices for

A. True-to-type trees
B. Pruning
C. Pollination
D. Pest and disease control
E. Irrigation

3. Grow-out nursery

Nursery standard practices established in relation to

a. Rootstock
b. Rotation using crops such as barley or wheat to control pests and diseases.
c. Nutrition
d. Irrigation
e. Weeds,
f. Pests,
g. Digging, and
h. Handling

4. Harvested tree standards

A. Trees accurately identified and labeled

Trees graded by

a. Size

May include:

1. Girth size above and below the graft
2. Tree height
3. No suckers
4. Distance (cm) from ground to first branch
5. etc.

3. Straightness
4. Disease free (viral indexing)

5. Inspection system

A. What to look for
B. When to inspect

Appendix 3. Example Certification System

Background

As the Afghan Almond industry moves to a system of developing and producing more true-to-type trees, it can be useful to have as a reference, a simple certification system. It is recognized that the Afghan Nurserymen themselves will be developing their own best practices system – a modification of a certification system. The material below (a simple tree certification system developed in California) provides the nursery men with a reference for collating ideas and deciding which elements they wish to include and when they will be included in their best practices system.

The California system involves three elements:

I. Proper Identification
II. Compliance

Each of these elements is expanded below.

The summary framework for the best practices system for Afghanistan is presented in section 2 of this document.

Organizations such as UC Davis's Foundation Plant Services can provide exhaustive guidelines for tree certification programs.

I. Proper Identification

Ensure trees are individually labeled and true to name.
They can be grouped by species and cultivar (where appropriate).

II. Compliance

- All trees shall comply with inspection regulations for plant disease, pests and weeds.
- Inspection certificates shall accompany each shipment or sale of plants.
- Clearance from the appropriate body shall be obtained before planting trees originating from other areas.

III. Tree Characteristics

The major elements covered under tree characteristics are:

A. Tree Health
C. Straight trunk
D. Roots
E. Moisture Status
F. Inspection
G. Delivery

A. Tree Health

Trees shall be healthy and vigorous.
1. Trees shall be free of pests (insects, pathogens, nematodes or other injurious organisms).
2. Trees shall meet minimum size and grade standards.

Appendix 4. 2007 Survey Findings - Summary

Summary findings from the September 2007 in-country visit and nursery assessment[1]

Nursery Source Materials & Procedures

- Nurseries do not have access to true-to-type varieties.
- Need for record keeping and verification of procedures.
- Handling procedures need improvement.

Nursery Site Selection

- Knowledge of need for good sites is uniform.
- Access to irrigation water.
- General understanding for nursery site rotation.

Nursery Site Preparation

- Minimal, and limited by resources.
- Affects Irrigation uniformity, effectiveness.
- Animal or DAP / Urea fertilizer applied before planting.

Rootstocks

- Bitter Almond
- Bought in bazaar, non-select parentage.
- Double row raised bed.
- Many different budding dates, all "T" budded.

Nutrition, Management & Pest Control

- Minimal nutritional knowledge.
- Spider mites and thrip problems.
- Irrigation problems. (Too much water applied)
- Weed problems.

Sales & Marketing

- Trees sold mostly at digging, some sales 1-2 months before digging.
- $1.00 - $1.50 each.
- True-to-type, quality increases sales, price.
- Growing, optimistic market outlook.

Survey Summary: Almond Nursery Business

- Optimistic market environment.
- Farmers are beginning to pay more for quality nursery trees.
- Lots of players [Nurseries, Farmers, Marketers, NGO's Government(s)].
- Nurserymen hungry for knowledge, improvement... willing to share with others.

Best Nursery Practices (BNP)

- Group decides standards.
- Certifies level of practice.
- Standards are upgraded as group's capacity and practices improve.
- Improved varieties, virus testing, etc., added as able.

[1] From report of John Driver 2007