ITTO PROJECT PD 386/05 Rev.1(F)
TECHNOLOGICAL DEVELOPMENT FOR THE PRODUCTION OF PLANTING MATERIALS TO SUPPORT SUSTAINABLE PLANTATION OF BALI INDIGENOUS SPECIES THROUGH COMMUNITY PARTICIPATION

Seed Collection and Handling

Panggal Buaya

Zanthoxylum rhetsa (Roxb.) DC

BALI PROVINCIAL FORESTRY SERVICE
AND
REGIONAL TREE SEED CENTER FOR BALI AND NUSA TENGGARA
AND
INTERNATIONAL TROPICAL TIMBER ORGANIZATION (ITTO)

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PREFACE

Bali Province has large degraded forest and land. Around 55.313 ha of land are classified as degraded and critical. In the mean time the demand on wood in Bali, particularly wood for handicraft industry has been increasing and the local wood production is not able to meet the wood demand. Wood-based local handicraft industry is an integral part of the tourism industry of Bali, taking up around 35% of wood consumption and providing a lot of job opportunities. Concern about the sustainability of the industry due to the deterioration of the resources has been growing.

The Provincial Government of Bali has addressed the above problems by embarking on the rehabilitation program of degraded forest and land by planting trees of indigenous species. The objectives are to empower local economy and improve environmental conditions, and to meet the ever-increasing demand of wood for local handicraft industry. Six indigenous species have been identified and selected in the planting program, and included in the International Tropical Timber Organization (ITTO) Project No: 386/05 Rev.1 (F) titled "Technological Development for the Production of Planting Materials to Support Sustainable Plantation of Bali Indigenous Species through Community Participation".

The availability of good quality of seeds and planting stocks as well as proper planting techniques have been identified as some of the many factors crucial for the success of planting program. This guideline is intended to provide information on seed collection and handling of *Zanthoxylum rhetsa* . The preparation of the guideline is part of the above ITTO Project and therefore the guideline is written heavily based upon the research findings generated from the same project and other experiences relevant to the subject.

The author hopes that the guideline will be useful for and benefit organizations or farmers involved in tree planting.

In this opportunity I would like to acknowledge the following individuals for their invaluable contribution to the preparation of the guideline:

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Tree Breeder and Silviculturist

Zanthoxylum rhetsa (Roxb.) DC.
Seed Collection and Handling

Taxonomy and Nomenclature
Family : Rutaceae
Vernacular/common names : kayu lemah (Java), kayu tanah, panggal buaya (Bali), dap-dap, harangan (Simalungun), ki tanah (Sunda) and kayu tana (Madura).

Natural Distribution and Habitat
Z. rhetsa is naturally distributed in India, Sri Lanka, Myanmar, Indochina, Thailand, Malaysia, Philippines, and southern Papua New Guinea. In Indonesia the species grows naturally in Java, Bali, Nusa Tenggara and Sulawesi. Generally it grows in open habitat, secondary and primary forests at altitudes from 150 to 700 m, a mean annual rain fall ranging from 1,850 to 2,500 mm, climatic type C-D (Schmidt and Ferguson). The species grows on a wide range of soil: mediteranian, regosol, alluvial, latosol and lithosol with soil texture ranging form light to medium. In Bali the species is found in the coastal area of Sumber Klampok- Buleleng, Tabanan, Jembrana, and Karangasem.

Uses
The wood is easy to work, not easily split or bent. It is used for light construction, furniture, wood carving, tool handle, keris sheath, gun stock and carving.

Botanical Features
Tree can achieve 35 m in height, and 60 cm in bole diameter, ever green, but sometime sheds its leaves in dry season. Outer stem bark is grey to brownish, thorny, inner stem bark has specific aroma. Leaves are compound with 5-8 pairs of leaflets. The leaflets are elliptical, wide at the base, asymmetrical and pointed at the tip, 2.5 cm wide, even or slight wavy margin, 10-15 pairs of vein. The flower is white, located at the twig terminal, 15 cm long. Female flower is slender and small. Male flower is very small. Ovule has one carpel.

Zanthoxylum rhetsa stem

Seed Orchard of *Zanthoxylum rhetsa*

Zanthoxylum rhetsa tree

Phenology

Z. rhetsa starts flowering before or after new leaves are formed. Flowering season occurs from March to April (Peninsular Malaysia) and from October to December (Java and Bali). When the flower is blooming it produces specific fragrance. Pollination is by insects. In Bali fruits ripen in January-April.

Fruit and Seed

Fruits panicles are located at the twig terminal, single and round with diameter about 7.5 mm, red to black color when ripe. Fruit is categorized as follicle. Seed is round, black and uneven surface, with diameter of 5-6 mm. The seed is oily and there is raphe on the surface of seed coat. There are approximately 15,000 seeds per kg. Seed contains essential oil with main component of sabinene (± 47%).

Fruits of *Zanthoxylum rhetsa*

Zanthoxylum rhetsa seeds (black)

Seed Collection

The best time for seed collection is from March to April. Ripe capsuls are indicated by red to black coloration of the capsul, and having seed moisture content around 20 %. Seed collection should be carried out before the capsul is open on the tree. The capsul can be collected by climbing or using ladder and cutting the fruit bunch at the terminal twig using pruning shear. The capsul may also be collected using pole mounted with hook or other devices that safe to use. The fallen capsuls are collected on tarpaulin sheet put under the tree. After harvesting seed should be cleaned from debris such as leaf and twig, then put in plastic, gunny or cotton bag.

Seed collection of *Zanthoxylum rhetsa*

Seed Handling

Capsuls should be dried immediately on tarpaulin or bamboo tray. Drying should be done in shade and not under direct sunlight for 2-3 days and then ready for seed extraction. Normally capsuls will be open at the third day, but the seed is still attached to the capsul.

Zanthoxylum rhetsa fruits after being harvested

Seed handling of *Zanthoxylum rhetsa*

Seed extraction is done by releasing seed from pods by beating the fruit stalk to the tray. The seeds are then washed with clean water and dried under sunlight for 1-2 days. Seed should be sown immediately in the sowing bed since it is recalcitrant which could not be stored for a long time without significant loss in its germination capacity.

Seed extraction of *Zanthoxylum rhetsa.*

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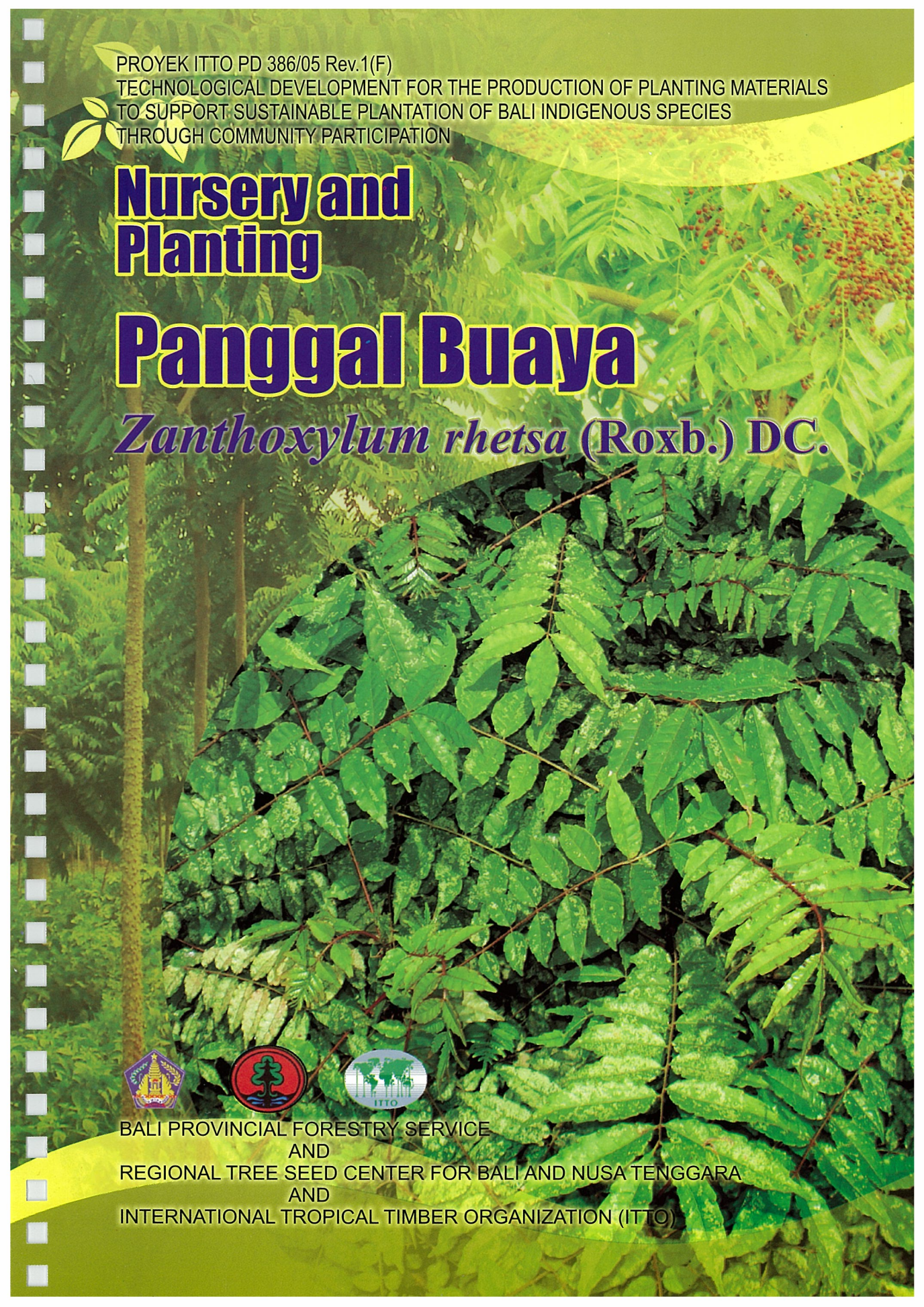
Nursery and Planting

Panggal Buaya

Zanthoxylum rhetsa (Roxb.) DC.



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The availability of good quality of seeds and planting stocks as well as proper planting techniques have been identified as some of the many factors crucial for the success of tree planting program. This guideline is intended to provide information on nursery and planting of *Zanthoxylum rhetsa*. The preparation of the guideline is part of the above ITTO Project and therefore the guideline is written heavily based upon the research findings generated from the same project and other experiences relevant to the subject.

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Eko Bhakti Hardiyanto
Tree Breeder and Silviculturist

Zanthoxylum rhetsa (Roxb) DC.
Nursery and Planting

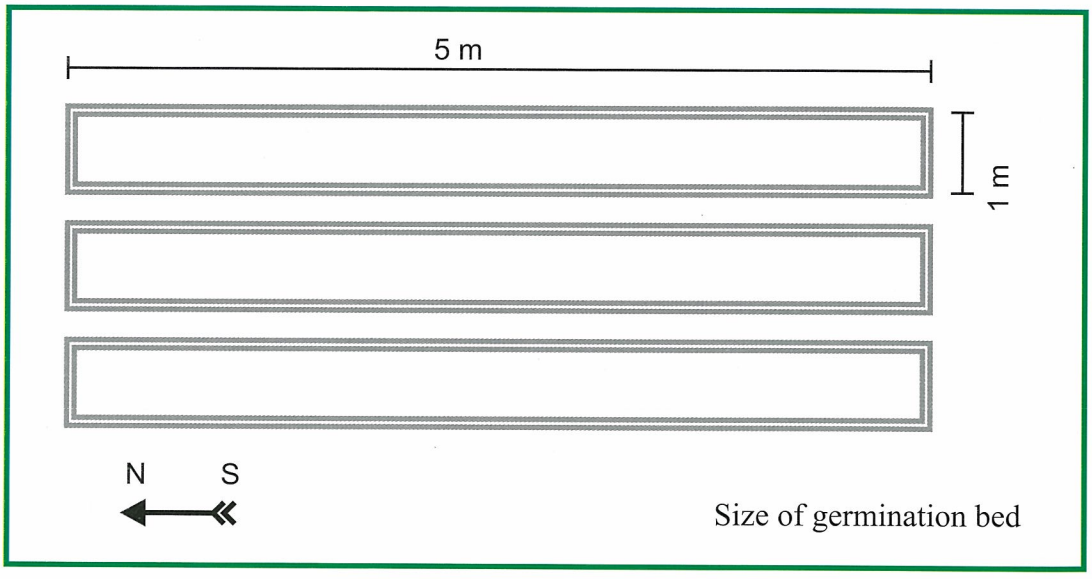
Site Selection of Nursery

The nursery site should be selected based on the followings:

a. Near the planting area to improve survival due to less damage during transport between the nursery and field.
b. Good accessibility to and within nursery.
c. Good topography (flat or gently slope) to make easy work. Low areas should be avoided as these will collect water at the low point and inhibit proper growth.
d. An ample, reliable and consistent water sources must be located nearby.
e. Workable soil.
f. Sufficient size to accommodate the number of seedlings needed to be raised.
g. Relatively easy to find workers.

Germination Bed

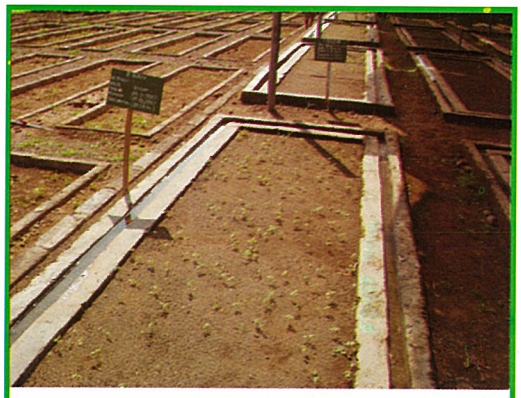
Germination bed with the size of 1 x 5 m may be prepared using brick, piece of wood or bamboo at the edge of the bed. Sowing media consist of fine sand. The media are put in the seed bed to a depth of about 15 cm. The surface of the media is leveled off to make easy for pricking and to prevent the root of seedling from damage during pricking. To reduce sun light the seed bed is put under shade using nylon net or coconut leaf (light intensity of 50 %).



Size of germination bed

Seed Sowing

Before sowing, pre-sowing treatment is needed by soaking the seed in tap water for 48 hours, washing the seed and changing the soaking water every day. Seed may also be soaked in the high concentration of sulfuric acid for 2 hours which can increase germination rate up to 40 %.

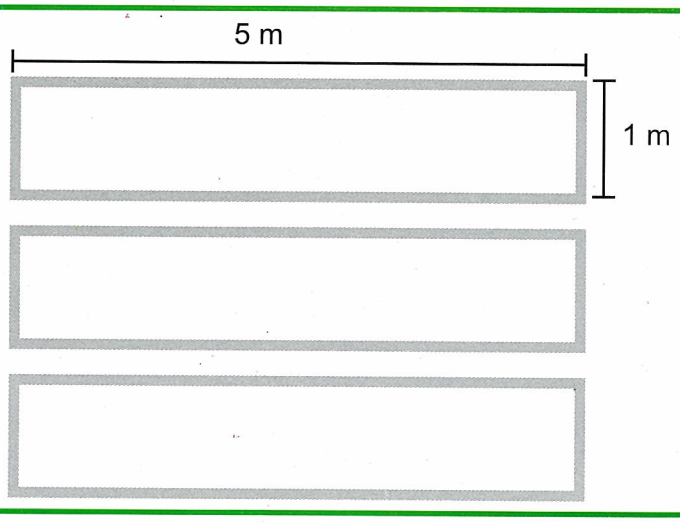


Germination bed of *Zanthoxylum rhetsa*

Seed is mixed with a mixture of fine sand and soil (1:1) and sown in the germinating media to a depth of about 1 cm and then covered with fine sand. Germinating media should be watered every day to maintain its moisture. The seed of *Z. rhetsa* is often attacked by ant and therefore the germination bed should be surrounded with water channel or sown some insecticide (desis/sevin) in the germinating media.

Nursery Bed

Nursery bed normally has 1 m in width to facilitate hand tending and the length of bed is 5 m or depending on available space. To prevent the polybag from falling the edge of bed should be supported with piece of wood, bamboo or brick. The filled polybag is then put in the nursery bed. To reduce sun light the nursery is put under shade using nylon net or coconut leaf (light intensity of 50 %).



Size of nursery bed

Nursery beds

Potting Media

Potting media consisting of a mixture of top soil and compost/ manure with a ratio of 8:2. The media should be mixed thoroughly before being filled into polybag. The potting media are filled manually by hand into the polybag with adequate density so that the filled polybag can be raised firmly. The polybags that already filled with media are placed in the nursery bed.

Filling the potting media into polybag

Pricking Out

Generally germination starts at the third week after sowing. Pricking out will start when seedlings have a pair of leaves, well developed shoot tip and hyphocotile and normal root. Pricking out should be done in the morning or late afternoon. The seedlings are pulled gently from the germination bed and their roots are then slightly soaked into the water in a plastic box . A vertical hole is made in the potting media to which the seedling will be planted using a bamboo stick. The root is then placed carefully into the hole so that it is not twisted. The seedlings are placed under partial shade (50 % light intensity) made of nylon net.

Nursery beds of *Zanthoxylum rhetsa*

Maintenance

Seedling maintenance includes weed control, pest and disease control and watering. Watering is done regularly, 1-2 times a day. Dead seedling should be replaced immediately. To obtain high quality seedlings are fertilized with NPK (15:15:15) at a rate of 10 g/l of water/m^2 of nursery bed given every week up to age of 4 months.

Weed control

Afterwards, seedling needs hardening off to make the stem lignified. During hardening off phase the frequency of watering is reduced, and fertilizer is no longer applied.

Seedlings with lignified stem will be more robust to be transported and planted in the field. At 2 months of age the shade is progressively open as *Z. rhetsa* seedlings grow better under full sun light.

Watering

Transportation

Seedling transportation should be carried out carefully as the young seedlings are delicate and prone to damage. To have high survival and optimal growth the following procedures should be taken:

a. Ideally seedling should be planted in the same day as it is transported from the nursery;
b. During transport extra care to the seedling should be taken, avoiding damage and direct exposure to sunlight;

Seedling transportation

c. If delay of planting is likely special treatment is required as follows:
   - store the seedling in a cool place and out of the direct sun at all times;
   - never let the root dry out, sprinkle them with water when necessary.

Planting site

Z. rhetsa generally grows at altitudes from 150 to 700 m, but in Bali it also grows at lower elevations (i.e. Sumber Klampok). The optimum mean annual rainfall is between 1,850 and 2,500 mm. The species grows better in areas with relatively short dry season (2-3 months). The species is found to grow on various soils: regosol (Inceptisol), Mediterranean and latosol (Alfisol). It prefers light to medium texture and well-drained soil.

Planting

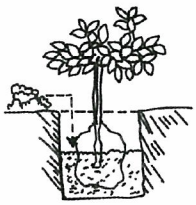
Normally seedlings are ready to be outplanted when they age 6 months old, 30-40 cm in height, more than 4 mm in root collar diameter and having 5 pairs of leaf. *Z. rhetsa* may be planted in forest and farm lands or wood yard. The initial spacing varies depending on the planting objectives: 3 x 3 m, 3 x 4 m, 3 x 5 m or 4 x 5 m. In an agroforestry system trees may be spaced accordingly based upon the available space, or trees may be planted in the form of fence planting. In this regard trees can be spaced 3-4 m apart.

a. Site preparation

   Site should be prepared accordingly to achieve a reasonable success in terms of survival and growth. Site preparation includes the followings:
   - Clearing weed and other unwanted vegetation;
   - Improving physical soil properties;
   - Marking out the planting spots with sticks and preparing the planting holes (40 x 40 x 40 cm). It is recommended to fill the planting hole with decomposed manure or organic compost at a rate of 3 kg per hole;
   - Transporting seedling to the planting spots.

Planting procedures

Prepare planting hole (40x40x40 cm)



Tear the polybag and plant carefully

Provide a stick for support

b. Planting

The following planting procedures should be undertaken:

- Tear the polybag carefully, make sure that the soil media are not broken. When there are cracks in the polybag, press the polybag with hand slowly so as to remake the soil media firm. Avoid root twisted when planting since this will reduce tree growth or cause tree death in later years.
- Place seedling root down to the bottom of the planting hole carefully and hold the stem, push the soil into the planting hole until it is well filled up to the root collar.
- Pack the soils tightly around the tree roots with sole of the boots so that no air pockets are left near the tree roots. The air pocket may be filled with water which can cause seedling death due to lack of air for root.
- Carry out planting at the early rainy season if possible when the soil has enough moisture.
- Prepare additional seedling (about 10 % of the total seedling planted) for blanking. Replace the death trees with new seedlings immediately soon after planting.

Maintenance

Trees are fertilized using Urea (30-50 g/tree), applied one months after planting. The fertilizer is placed at furrow or holes at a depth of 10 cm, about 15 cm from the tree. Second fertilizer application is done at 4-6 months old with Urea at a rate of 100 g/tree.

Weed control is carried out by clearing weed around the trees. It is done until the trees are capable of competing and suppressing the weed.

Planting *Zanthoxylum rhetsa* in the field

Trees may have multiple stems, or forked branches starting at very low part of the stem. Multiple stems should be reduced to only single stem to improve stem form and quality. This operation is called singling. Singling is done by removing poor stems and leaving only one best stem. Singling should be done at early growth phase of trees when trees start showing multiple stems.

To increase wood quality, pruning needs also be carried out. Big branches not easily self-pruned should be pruned, otherwise the log quality will be poor.

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