

# Nursery Block Manufacturing Manual

– For arid and desert areas –



OYO Corporation



Japan International Forestry  
Promotion and Cooperation Center



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## 1. What is “Nursery block”?

“Nursery block” is a soil block which consists of soil, compost and clay, which are molded into a tubular shape by special equipment. The nursery block has a hole in the middle in which soil is filled and seeds are sowed as a growth base for plant seedlings. Seedlings which are grown in the block are called “nursery block seedlings”.



Photo 1 Nursery block



Photo 2 Nursery block seedlings

### Features and effects of nursery blocks

#### 1) Features by structure

The key feature of the nursery block is that the root system of the plant extends straight and deep into the ground through the hole like a natural tree. As a result, the nursery block produces the following benefits.

##### (1) Planting forests to help protect the environment

In Japan with its steep topography, trees whose thick roots extend straight and deep into the ground and whose lateral roots spread widely are planted, thus helping to prevent disasters. The wide-reaching lateral roots and net-like structure of entangling with the root systems of adjacent trees help to suppress soil erosion; the planted forests conserve the soil and water sources.

##### (2) Improvement of survival rate in arid areas

The surface of dry ground which has little vegetation and receives direct sunlight is extremely hot and dry. However, the temperature of the soil deep underground is stable and retains more moisture than the ground surface. The nursery block encourages the root system to extend deep into the ground where the roots can efficiently absorb moisture in the soil, thus increasing the retention rate in arid areas.

## **2) Features of materials**

Nursery blocks are an environmental-friendly product made of soil and organic matter, and not petroleum products such as plastic and vinyl. Moreover, other than the equipment to manufacture the blocks, nursery blocks are a kind of greening material which can be made from local materials, and so have the following advantages.

### **(1) Greening material that does not pollute the environment**

Because nursery blocks are not made of materials that do not decompose in the natural environment such as petroleum products, no garbage remains after planting, thus avoiding environment pollution. Moreover, recycled resources can be effectively used by using river sediment as a soil or using garbage compost as organic matter.

### **(2) High potential for people thanks to ease of block preparation**

Only equipment for manufacturing nursery blocks is needed, as the blocks are made of only soil and organic matter, and so can be easily produced in developing countries with few high-tech materials. For this reason, people in developing countries can produce their own nursery blocks and continue greening activities.

## **Mechanism of plant root development**

In the nursery block, the plant roots extend deep into the ground by the following two mechanisms.

### **(1) Protection of taproot by air root cutting**

In the nursery, seedlings in the nursery blocks grow on a steel net. When the taproot reaches the bottom of the block and touches the air it temporarily stops growing. This technology is called “air root pruning”, and is different from physically cutting the roots by scissors. The taproot that has stopped growing by air root pruning will grow again after planting, straight and deep into the ground.

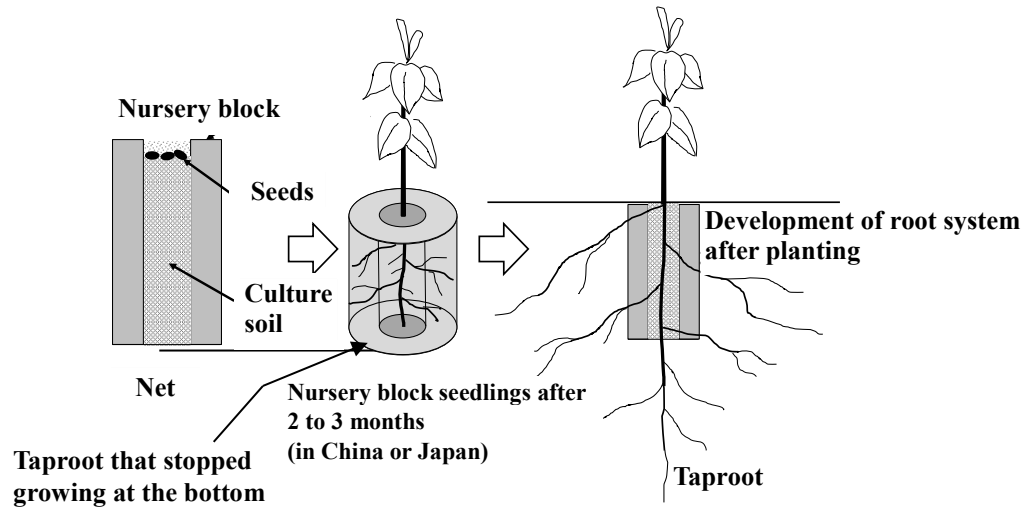


Fig. 1 Growth of nursery block seedlings and development of root system

(2) Promotion of root system development by high retention of water and fertilizer

As nursery blocks contain a large amount of clay, they effectively retain water and fertilizer. This feature provides nutrients and moisture intensively to the plant, protects its growth during the early stage, and speeds up growth of the root system.

## 2. How to manufacture nursery blocks

The materials and method of manufacturing nursery blocks are explained below, assuming the blocks will be used in dry and degraded areas overseas.

### 1) Materials

The four main materials used for manufacturing nursing blocks are: soil, organic matter, clay, and chemical fertilizer.

#### (1) Soil

A local soil is used, such as farmland and grassland top (surface) soil.

The most suitable soil is an aggregate soil (so-called loamy soil, or clay loam soil) with high water retention and permeability. Choose a soil that has a highly developed aggregate structure.

In overseas countries, pay attention to the pH and electrical conductivity (EC) of the soil. The pH of mineral soil (dry soil with low organic matter) in a dry area is typically pH 7.0 to 9.0.

It is possible to produce nursery blocks even using soil with a pH exceeding 9.0, but due to the low solubility of essential trace elements such as iodine, iron, and manganese, deficiencies of such elements may occur. In this case, consider using a basal fertilizer such as ammonium sulfate acidic fertilizer containing trace elements. The appropriate EC value of dry soil is around  $0.20\text{--}0.60\text{ dSm}^{-1}$ . Avoid using soil with an EC value exceeding  $0.80\text{ dSm}^{-1}$  1).

#### (2) Organic matter

Use an organic matter containing 1–2 cm of fibrous material. Using finely crushed organic matter may weaken the nursing blocks and the large amount of air contained may cause the blocks to collapse during the process of formation. Such nursery blocks may also be poor in drainage.

Another organic matter is manure, which can easily be purchased in arid areas. Because cattle are often kept in stables, cow manure compost is comparatively easy to obtain. In this case, it is also necessary to check the EC of the manure.

Note that unfermented compost contains livestock feces and bedding straw which are sources of manure, and so have very high EC values due to urine. In Japan, we use a manure with EC of less than  $5\text{ dSm}^{-1}$  recommended by the Japan Central Union of Agricultural Co-operatives<sup>2)</sup>.



Photo 3 Cow manure

1) excerpted from "Salt-affected soils in Australia (P. Rengasamy 2016)"

2) Preferred reference for quality preservation of organic materials such as compost (Japan Central Union of Agricultural Co-operatives, 1994)

When using immature compost, regardless of the type of manure, care is required not to inhibit plant growth during the fermentation process. In addition to cow manure compost, there are also horse manure compost, peat moss and compost of mowed grass.

### (3) Clay

When using soil with low clay content, clay should be added. In Japan, domestic soil with high clay content is used. Clay is often used for making bricks and as a construction material in arid lands, and so can be easily purchased from brick manufacturing factories or construction sites.

Avoid using a material containing coarse sand (size that can be seen visually). If the material contains a lot of coarse sand, it will become trapped in the gaps of the nursery block manufacturing equipment, making it difficult to produce the blocks.

### (4) Compound fertilizers

As compounding fertilizers, it is recommended to use compound fertilizers containing nitrogen (N), phosphate (P) and potassium (K), particularly those containing a large amount of phosphoric acid which facilitates growth of the root system. Many soils in arid land are strongly alkaline and the availability of trace elements such as iodine, iron, and magnesium is low. For this reason, it is preferable to use a composite fertilizer containing these trace elements.

## 2) Necessary equipment

### (1) List of equipment

The following equipment is needed to manufacture nursery blocks:

- Nursery block manufacturing equipment
- Sieve
- Bucket
- Scoop
- Plywood plate
- Measuring cup
- Scale

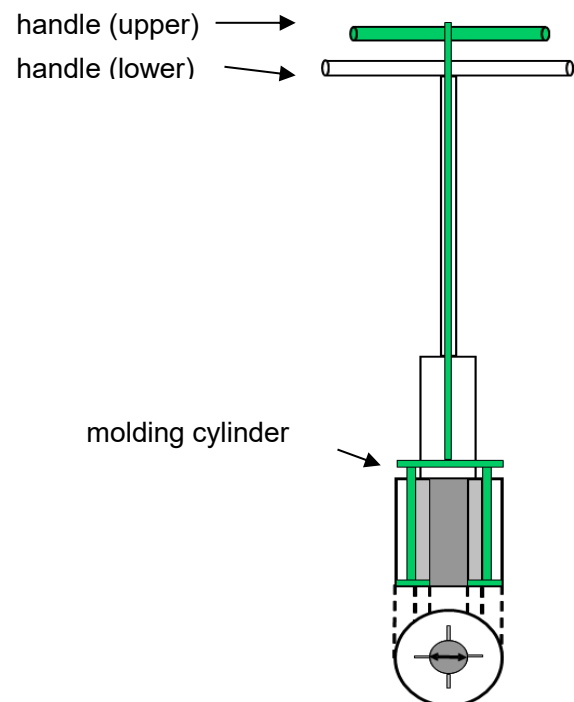


Fig. 2 Schematic diagram of nursery block manufacturing equipment

## (2) Mechanism of nursery block manufacturing equipment

Figure 2 shows the structure of the nursery block manufacturing equipment. The green handle and the steel plate in the cylindrical tube are interlocked. As material is filled in the cylinder, the steel plate is pushed up, and the green handle also moves at the same time. After packing the material into the cylinder, the green handle should be pushed downward to mold (produce) the nursery block.

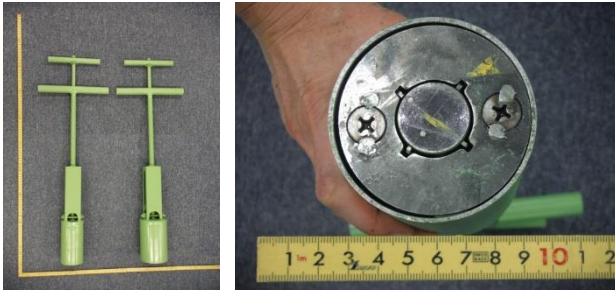


Photo 4 Nursery block manufacturing equipment before packing materials



Photo 5 Steel plate and handle after pushing up

## 3) Manufacturing procedure

The method for manufacturing nursery blocks is shown below.

### (1) Preparation

Sieve the soil, compost and clay, remove stones and dirt, and loosen any lumps. The mesh size of the sieve used for soil and clay is approx. 0.5–1.5 cm, and that for compost is approx. 2.0–3.0 cm.



Photo 6 Soil sieving work

### Note

You can sieve large quantities efficiently by using a wire mesh sieve with a wooden frame and by tilting it at an angle.

### (2) Mixing

Mix dry soil, compost, clay and chemical fertilizer on a plywood plate. If the materials are not uniformly mixed, it will be difficult to pack them into the nursery block manufacturing equipment, so mix them well. According to the nursery block patent<sup>1)</sup>, soil should occupy 50–80% of the weight of the mixed material.

1) Patent No. 4660635: Greening method by using a nursery block



Photo 7 Material mixing



☛ Note

Mix the materials in the volume ratio of soil : organic matter = 1 : 1. If dried nursery blocks break or hardly absorb water when submerged in water, change the proportion of soil and organic matter and/or add clay.

After mixing the dried ingredients, add water and mix them well again. While rolling the material into dumpling shapes, add water until the rolled hand becomes moist.



Photo 8 Mixer

☛ Note

Using a horizontally rotating mixer makes it easy to mix the materials. When using a mixer, it is more convenient to choose one with the slot on the bottom. However, three-phase power is not available everywhere, so the workplace should be carefully selected.

(3) Molding

Push the nursery block manufacturing equipment into the mixed materials and fill them into the equipment. While doing so, the iron plate inside the equipment will be pushed upward and the upper handle will naturally rise. Push the material with the equipment until the tube becomes full and the handle does not move.



Photo 9 Molding process

☛ Note

If you slightly rotate the equipment while pushing, the material will easily enter the equipment.

#### (4) Extrusion

Push the upper handle downward to extrude the material out from the equipment.



Photo 10 Extrusion of material

#### (5) Drying

Place the extruded nursery blocks on the plywood plate and allow them to dry. If the blocks are used without drying, they may break as the seedlings grow, so be sure to dry them completely.

Allow sufficient space between blocks to facilitate drying.



Photo 11 Drying of nursery blocks

## Contact

◎ Question regarding nursery block

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\*The patent for nursery blocks in Japan belongs to Mr. Yoshinari Yamadera.  
Patent No. 4660635: Greening method by applying nursery block  
Patent No. 4666833: Seed-bed, manufacturing method and sowing method

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