



Norway's International
Climate and Forest Initiative
(NICFI)

Guidelines for the Establishment of Breeding Seed Orchards (BSOs)

2021

TECHNICAL

Guidelines for the Establishment of Breeding Seed Orchards (BSOs)

PATSPO 2021



This guideline is prepared and published by PATSPO.

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Introduction

This is a publication giving guidelines for the establishment of breeding seed orchards (BSOs) in the auspices of the PATSPO (Provision of Adequate Tree Seed Portfolios) program.

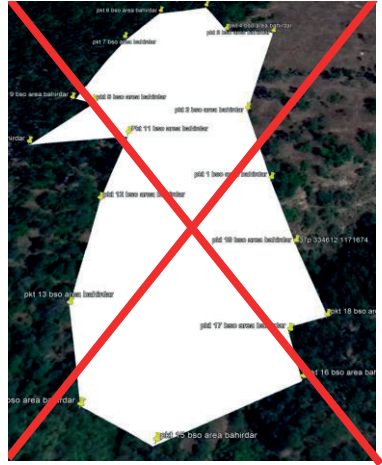
The BSOs are established to provide improved, healthy, climate resilient and genetic diverse material for the Ethiopian forest and landscape restoration programmes.

A BSO consists of families from selected trees as well as offspring from provenances. Through genetic thinning where inferior genotypes are removed, the BSOs will provide improved seed for the restoration programmes.

The following are the main activities that need to be carried out during the establishment of BSOs:

- Identification of areas suitable for BSOs
- Nursery part
- Labelling and counting of seedlings
- Layout of BSO in the field
- Packing of seedlings for the BSO for planting
- Planting of the seedlings in the field
- Registration of genetic entries in the BSO

Identification of areas suitable for the BSOs



The area for BSOs should be as **uniform** as possible concerning soil conditions and altitude, easily accessible, protected by fences and with the right climate.

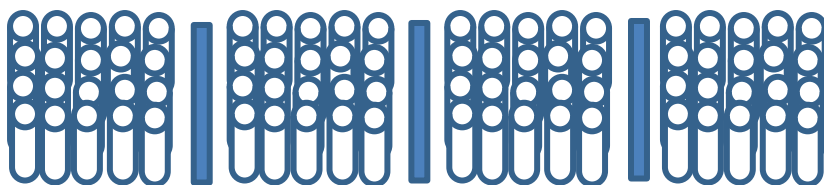
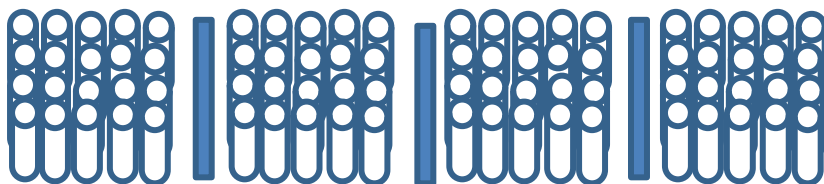
Areas with a heterogeneous environment due to hills, different soil conditions e.g. water stagnation in some parts, should not be used for BSOs.

Avoid areas surrounded by the same species as the species to include in the BSO.

It is highly preferable if the area is reasonably **regular**, i.e. rectangular or quadratic.

Nursery part

Containers (plant pots) are prepared and placed in separate



batches for each genetic entry, which will be included in the BSO. There should be space between the batches and a stick between the batches before the arrival of seeds.

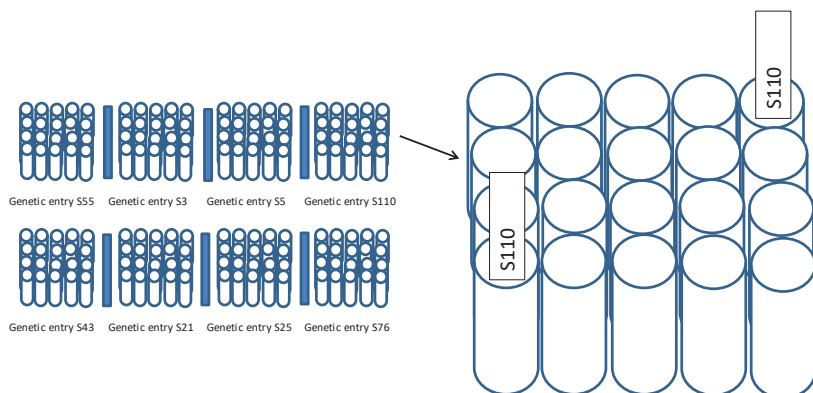


Containers (pots) are placed in separate batches for each genetic entry and with clear space between the batches and a stick between the batches.

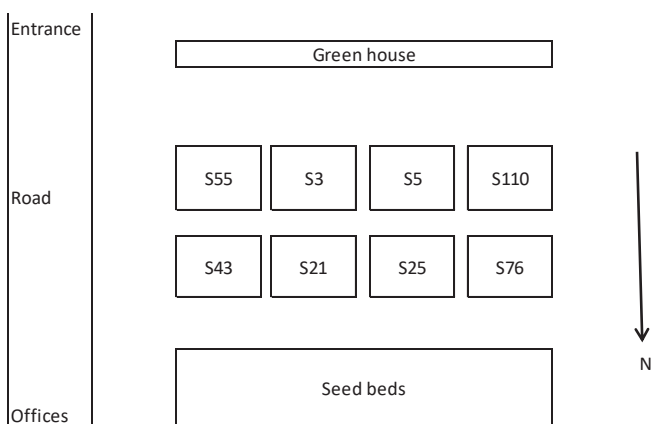


Seed will be delivered in bags with an attached label with the number of the genetic entry and a label inside the bag with the number of the genetic entry as well.

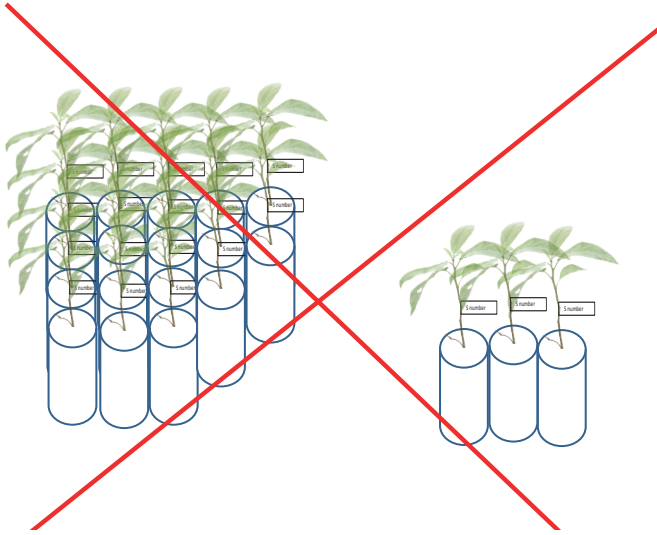
Information is provided on the number of seeds that should be sown in each container of the specific genetic entry.



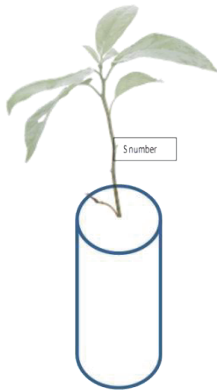
After the sowing of a genetic entry, at least two containers should have a label with the number (S-number) of the genetic entry.



Immediately after the sowing, register where the different genetic entries are placed. Make a map showing the location and mark the direction to north on the map.



In case of root cutting, lift the containers one by one. Preferably, do not change the location of the batches during root cutting to avoid later problems identifying the genetic entries.



Labelling and counting

The final number of seedlings per genetic unit is counted. Labels are pasted around each seedling with the S-number of the genetic entry.



Labels are pasted around each seedling with the S-number of the genetic entry.

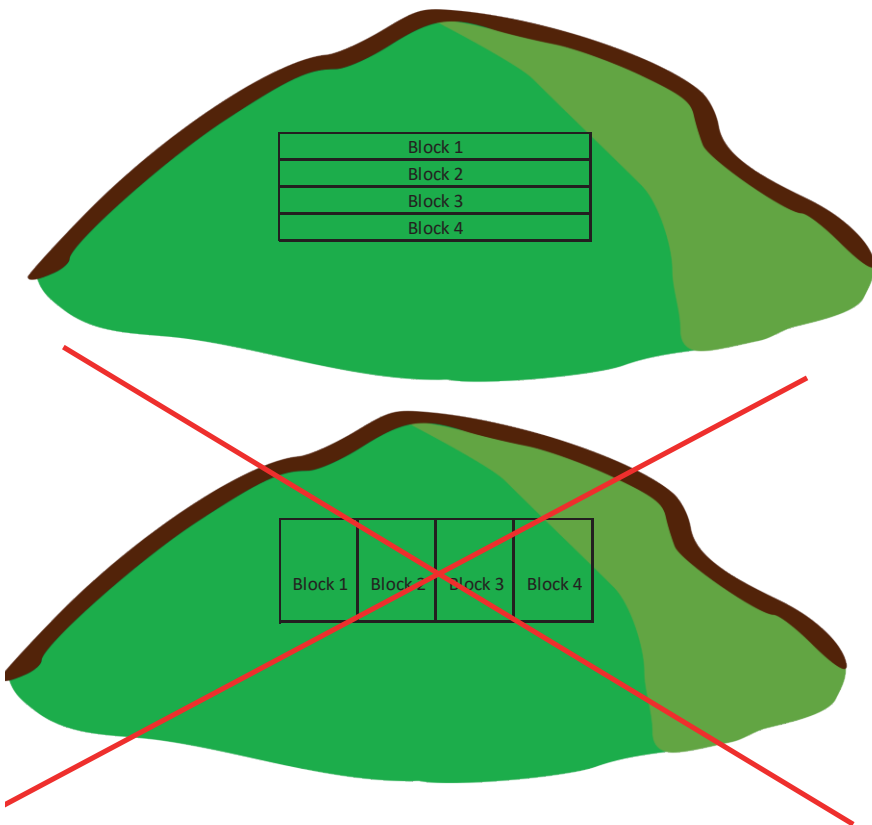


Some principles on the layout of BSO

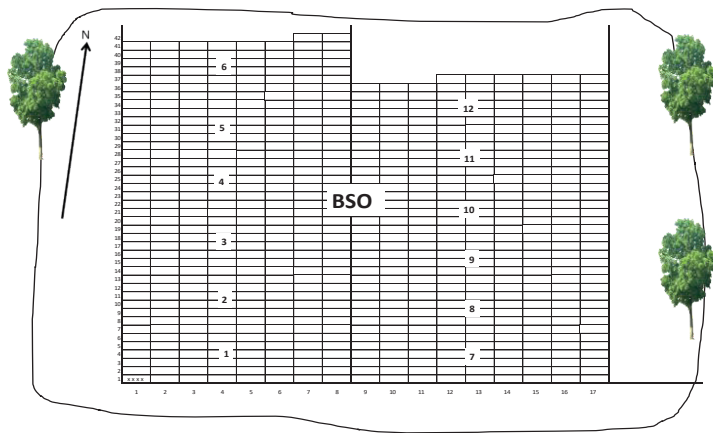
8	7	1	15	10	4	3	11	12
7	16	14	9	2	5	8	6	13
6	9	11	16	14	2	3	5	6
5	7	4	13	10	1	15	12	8
4	6	11	15	7	13	2	3	10
3	4	12	14	8	5	16	1	9
2	5	14	15	6	13	9	2	4
1	7	8	12	3	11	16	10	1
	1	2	3	4	5	6	7	8

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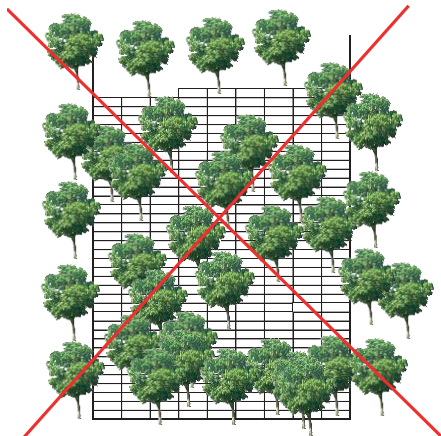
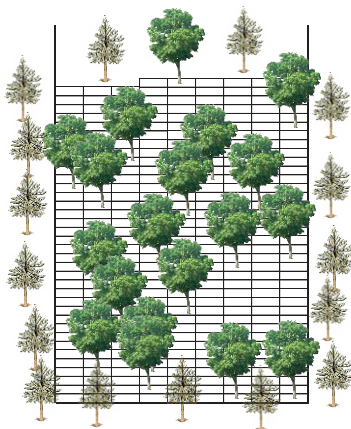
An example of a BSO divided into four blocks. 16 genetic entries are included. Each genetic entry (1-16), is represented in all blocks. The blocks are shown with different colours.



If the area for the BSO has a slope, make the layout of blocks so the variation in altitude within a block is as small as possible.

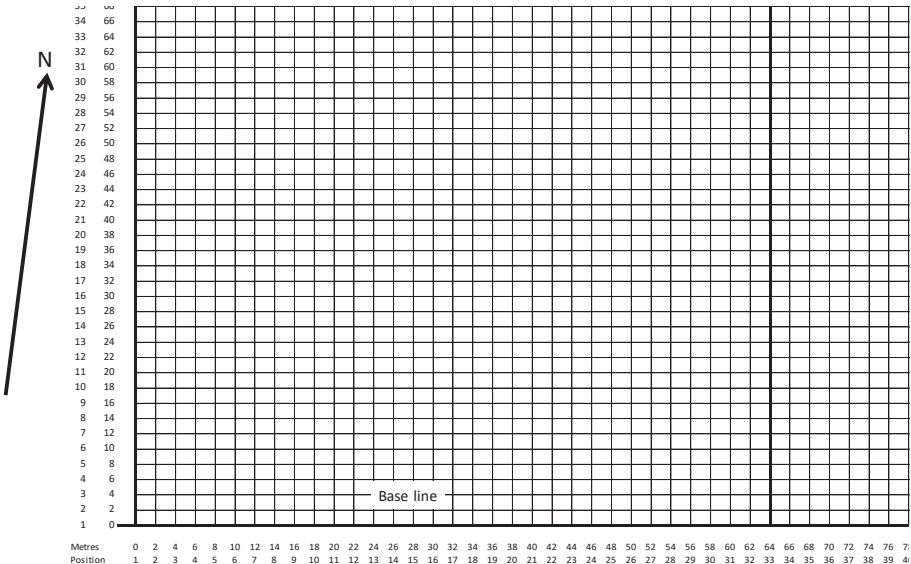


Leave some space between the BSO and large surrounding trees.



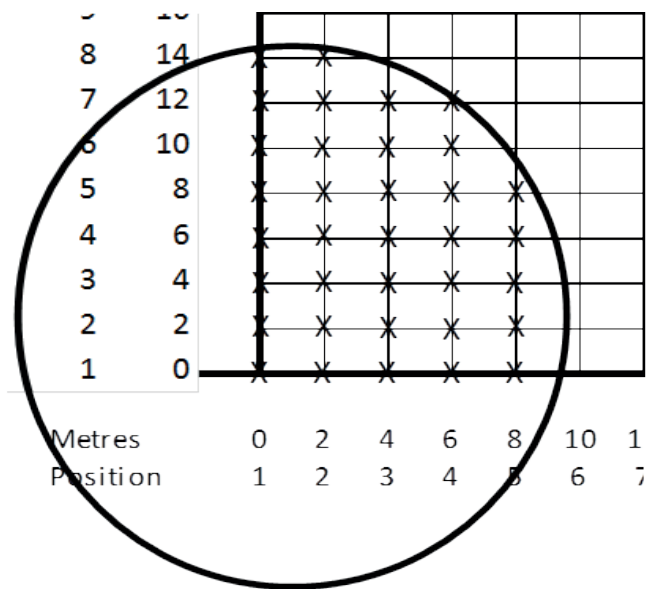
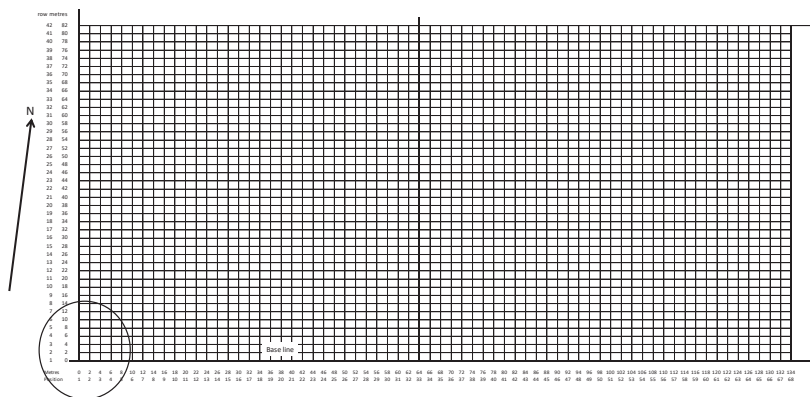
Border trees should be of different tree species to make it easier to find the border of the BSO in the future.

Layout of BSO in the field

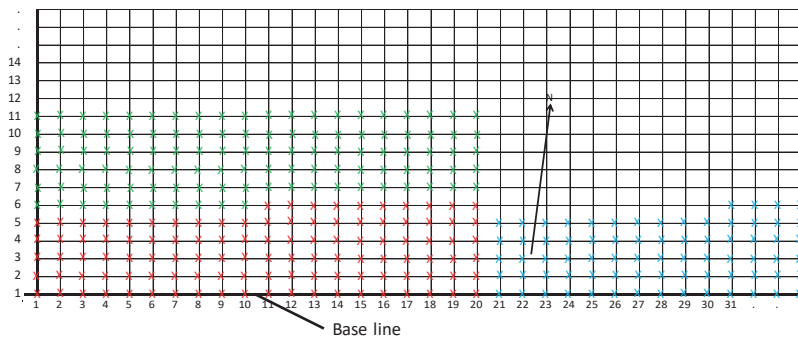


A grid with rows and positions should be laid out for the BSO corresponding to number of trees to be planted.

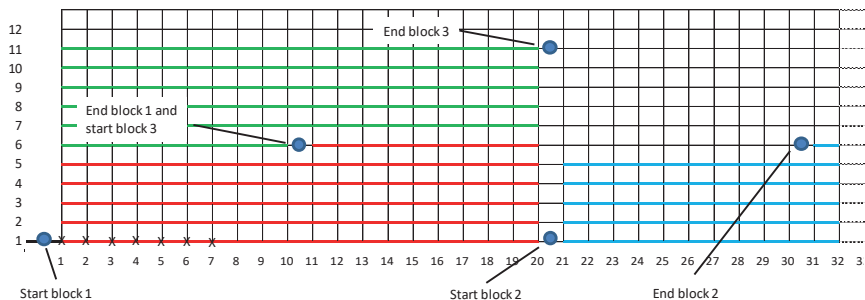
The baseline, which is used for the layout of rows and positions, is normally the longest line in the BSO



The pits for seedlings are made where rows and positions are crossing each other - shown with crosses above.



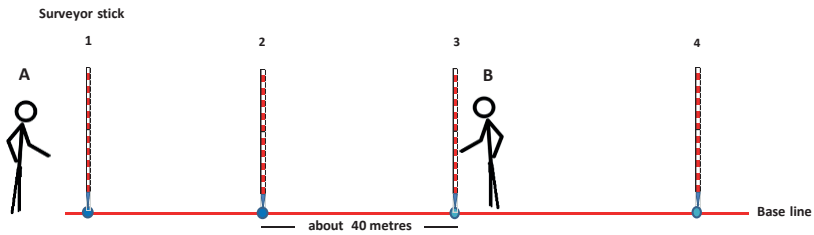
Pits for seedlings are in this example shown for three blocks with different colour. Each block consists of 110 seedlings.



Mark the start and end of the blocks with poles.

To make the layout in the field, you will need

- Two measuring tapes of at least 50 metres
- Cord of at least 150 m. The cord should preferably be static and not dynamic, so it will not change length when stretched.
- Surveyor sticks/ranging poles (alternatively long straight sticks)
- Sticks to mark the positions of blocks in the field



Surveyor sticks and long cords are used to make the layout of the baseline for the BSO.

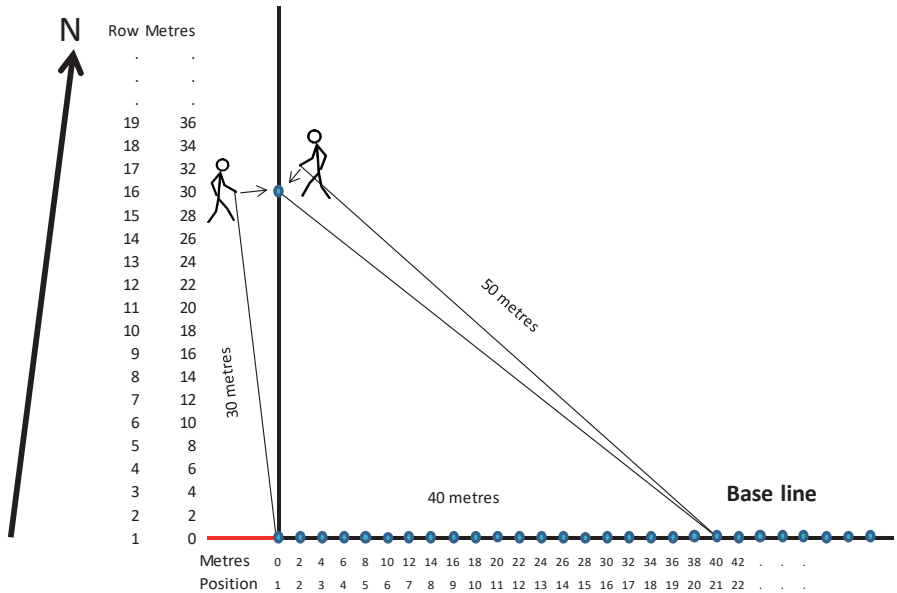
Firstly, surveyor sticks 1 and 2 are placed to mark the beginning of the base line.

Secondly, the base line is then extended using lines of sight. Thus, operator A is guiding operator B to place stick 3, so it is in line with stick 1 and 2.

Poles (blue filled circles) are used to mark the base line and distance between positions. A cord is stretched over the full line at the end.



Poles are used to mark the base line and positions. A cord is stretched over the full base line.

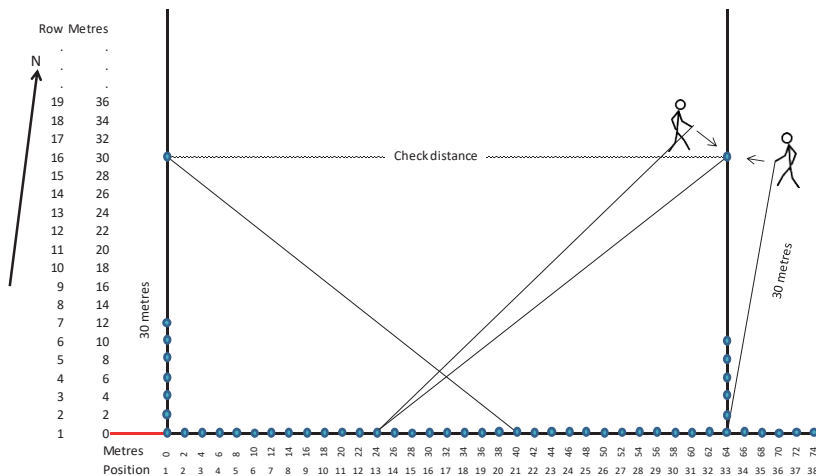


Vertical lines to the base line are made using the equation of Pythagoras.

Mark up 40 metres from origin (0 metres) in line with the base line. Set a stick at origin and at 40 metres, respectively.

One measuring tape of 30 metres is fixed to the stick at the origin. Another measuring tape of 50 metres is fixed at the stick at 40 metres.

The vertical line is now found where the measuring tape of 30 metres and the measuring tape of 50 metres are meeting each other.



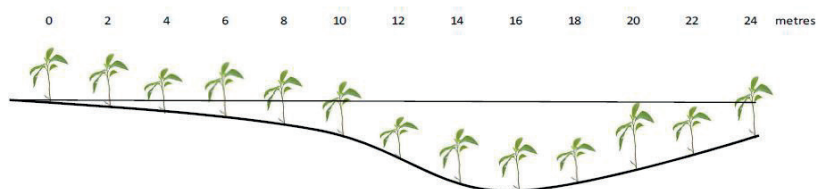
The vertical lines are extended with surveyor sticks or long sticks using the procedure outlined for the base line.

Poles (blue dots) are used to mark the rows - here indicated with some few poles at each of two vertical lines. Poles are also used to mark the positions.

Check the distance between the two vertical lines to make sure it is as expected.



Cores are stretched from the poles to mark the rows. Pits are here made for every 2 metres following the rows in the BSO.



The distance between pits made for the plants, is made based on the stretched cord in case of small hills.

Packing of seedlings for the BSO



Boxes will be used for the transport of seedlings to the BSO.

Labels with block numbers are pasted onto the boxes, so people in the field know which block the seedlings in the boxes should go to.

Packing list

Packing list		
S-number	Block	N plants
S55	1	2
S43	1	1
S110	1	1
S3	1	1
S25	1	1
S5	1	1
S21	1	1
S76	1	1
S-number	Block	N plants
S43	2	1
S55	2	2
S5	2	1
S3	2	1
S21	2	1
S25	2	1
S110	2	1
S76	2	1
S-number	Block	N plants
S5	3	2
S25	3	1
S76	3	1
S55	3	2
S21	3	1
S43	3	1
S3	3	1
S110	3	1

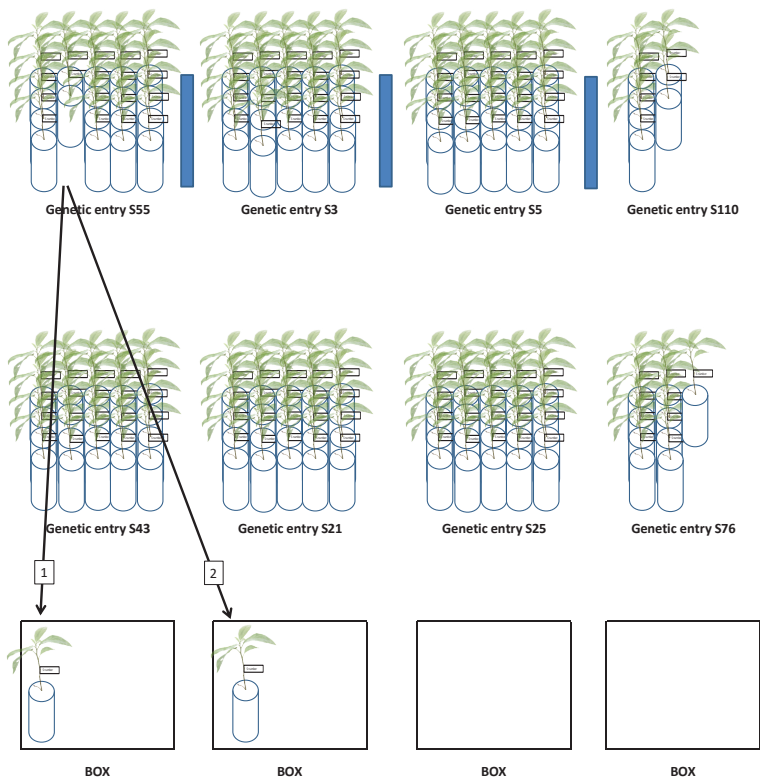
A packing list will show the number of seedlings per genetic entry to distribute to the different blocks.

In this example, seedlings from eight genetic entries (S-numbers) will be distributed to three blocks.

Notice the random order of genetic entries (S-numbers) for each block. This random order should be used when the seedlings are placed in the boxes for a block (see next pages).

Only one block at a time should be packed.

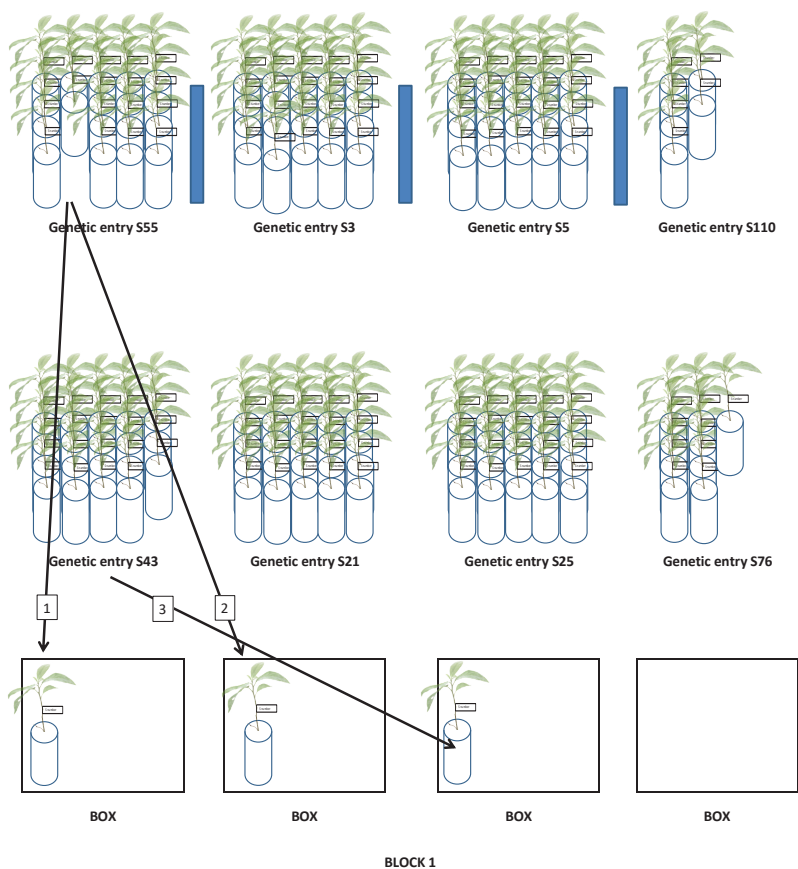
Seedlings should be placed in the boxes for a certain block, in the order shown in the packing list.



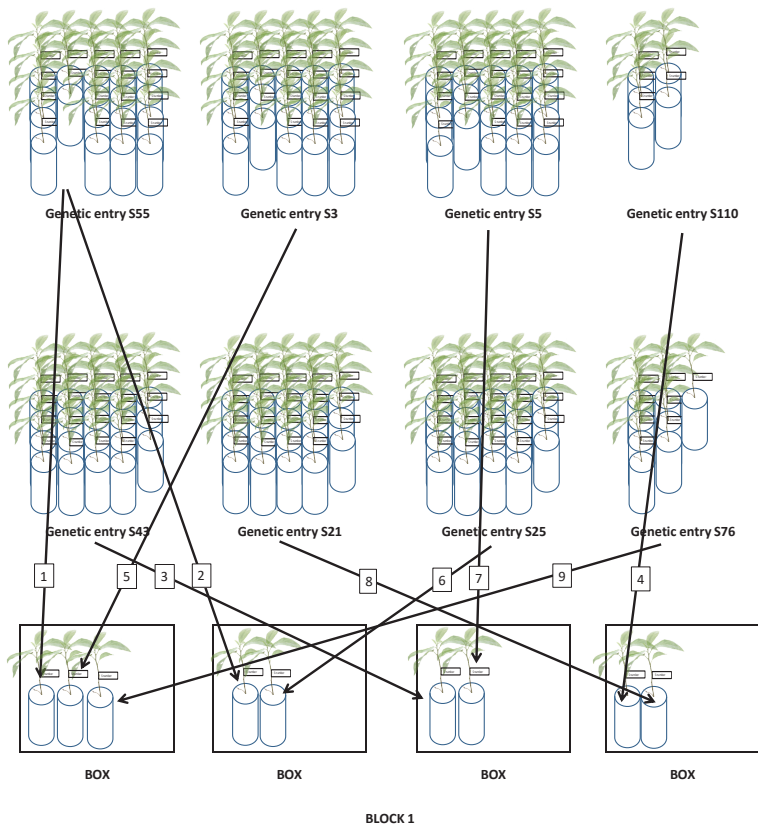
BLOCK 1

In case a genetic entry should be represented by more than one seedling in a block, the seedlings from the entry should be placed in different boxes.

In the example above, two seedlings from S55 should go to block 1 and they are placed in different boxes.



The next step is to place seedlings of the next genetic entries in the boxes following the order of the packing list – here genetic entry S43 is following S55.

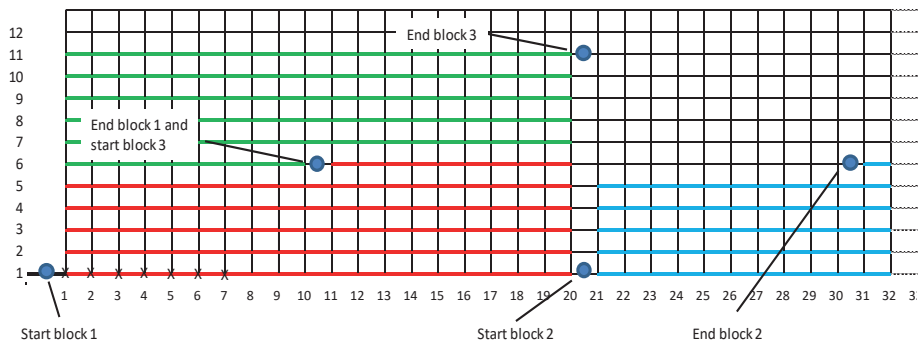


Seedlings from the remaining genetic entries are placed one by one in the boxes according to the order shown in the packing list.



Seedlings are placed in boxes and in the order shown in the packing list. See the procedure at the previous three pages.

Planting of the seedlings in the field



When the boxes arrive in the field, it is of importance that the seedlings in boxes with the label “block 1” are planted in block 1, seedlings in boxes labelled “block 2” are planted in block 2 etc.

Make the plantings one block at a time.

Registration of genetic entries in the field

After the seedlings are planted, the position of the genetic entries in the BSO will be registered by PATSPO - reading the labels of the trees. This registration will be used for the establishment report, including a map showing the positions of genetic entries in the BSO.



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