



## **Sycamore Seed Orchards & Tree Seed Processing in Germany**

### **Visit Report - Sycamore Sub Group**

**Germany**

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## **I. Introduction**

FTT has currently only one established sycamore seed orchard (SO) with a full compliment of all plus trees from the UK and Ireland, at AFBI Loughgall in Northern Ireland which was planted in 2011.

As part of the sycamore group business plan, a visit to other sycamore orchards in continental Europe had been discussed and approved by its members. Arrangements were made with Dr. Helmut Grotehusmann in Germany to visit and learn practical and scientific aspects of seed orchards and tree seed processing which would help to improve the supply of seed from trees of better quality in the UK and Ireland.

## **II. Recommendations on seed orchards (SO) from a German perspective**

- Use as many clones as possible in a seed orchard provided the plus trees are from well adapted provenances. A low starting number e.g.25-30 may leave just 8 -10 genotypes after progeny testing and genetic culling; this is too few.
- Use many ramets per clone 4-10.
- Many ramets per clone allows for genetic thinning based on performance of the progeny. Distribute ramets in such a way that the same number of genotypes will constitute the SO after thinning / respacing.
- Establish seed orchards at several sites in different regions with the advantages:
  - Safeguards against site failure
  - Many facilitate more consistent and uniform seed harvests annually
  - Different plus tree clones may flower at different times periods in a given year and a variety of flowering periods at different sites may allow you to obtain more reliable seed production.
  - Seed production may vary at different sites due to local weather conditions.
  - Different plus tree clones may flower in different years
  - Recording of flowering each year in seed orchards is important
  - Recording of seed formation in seed orchards for each year is important
  - Test the material from Seed orchards in dedicated trials comparing their performance against commercial seed lots of sycamore

Recommendation – Collect seeds from various seed orchards in different regions. Mix the seeds before deployment to nurseries.

This will ensure that many different mother trees will have contributed to the seed lot and genetic diversity in the progeny will be maximised.

- **Progeny testing**

For the character of 'tested' to apply to a seed source the progeny must be tested and evaluated against regular commercial stocks of plants derived from commercially available seed sources. Performance evaluation should be for 12-16 years. The German protocol is to test the material on 5-6 sites using 5-25 trees/plot with 3 replicated plots/site.

The performance of progeny may be based:

- a) on the performance of progeny from individual plus trees
- b) on the performance of a seed lot from a seed orchard consisting of an equal mixture of seed / plants from many plus trees in the seed orchard

To test the performance of the progeny from individual plus trees, they use 16 trees per plot, with 3 replications per site = 48 test trees per site. It is necessary to make provision of 'reserve' plants for each site for beating up (ie 12 plants). Therefore, for a progeny trial with sycamore it would require a total of 60 progeny trees from each plus tree for each test site. For 5 sites it requires 300 trees. In Germany, they usually test 20-30 progeny in each trial.

To test the performance of a seed lot from a seed orchard the progeny (seed) from individual mother trees is equally mixed. A better arrangement would be to germinate the seeds and after germination to provide for the test, an equal number of plants derived from each of the mother plus trees. In this case the test would require 300 trees i.e. 60 trees planted on each of 5 sites (as above).

In order to receive the official designation of 'Tested' the performance of material from the seed orchard must be proven to be significantly better than commercial material for at least one character such as height growth, dbh, stem-form etc.

- **'Forest laws' in Germany on seed stands and seed orchards**

Beech stands must have a minimum of 40 flowering trees (genotypes) and a minimum of 20 trees (genotypes) per stand bearing seeds.

Sycamore stands and seed orchards must have a minimum of 20 flowering trees and 10 trees (genotypes) bearing seeds before seed collecting is allowed. The minimum area for a seed orchard is 0.25 ha. It was emphasised that orchards should maximise the number of plus trees that constitute the S.O. eg at least 50 (plus trees) should constitute a S.O. This allows for genetic culling of bad parental trees which are identified after progeny testing. Larger numbers of genotypes of plus trees in the S.O. also allows the possibility to collect seed from many different progenies.

### **III. Stop 1 Nidderau seed orchard (near Frankfurt)**

This is a 2.8 ha sycamore seed orchard established 1981 at 5m X 5m spacing (Fig.1). We were surprised to find that this S.O. had many big trees with full crowns and also trees of varying ages, the youngest being approx 8 years old. This reflected losses at establishment and during the past 3 years. Some large trees were shading younger ones and this S.O. needs radical thinning. It was suggested that thinning/pruning should be done at least every 5 years. Although pruning is not a regular practise in SO management it was suggested that the branches might be pruned to give large crowns with a clear stem for 1/3 of the total height.

Flowering each year is recorded and differences among clones in seed production have been observed. Although the artificial stimulation of flowering is not practised (e.g. growth regulators etc), in some orchards beekeepers are invited to place hives of honey bees to aid pollination.

In Germany they allow a period of 10 years to completely establish an orchard before handing it over to the seed collection & processing division. Initially this S.O. consisted of 54 different clones with a total of 9-20 ramets of each clone. The irregularity of trees in terms of height and age was a result of replacing dead trees during the first 10 years which is the period allotted to complete a seed orchard in Germany.

This 2.8 ha site produces regular crops of 500 kg seeds in good years. See Figs 1 & 2. Seeds are collected by hand either by climbing trees or by knocking off seeds onto nets. Seed collectors are paid per kilo. The rate / kilo depends on the ease of collection in any give year. With a good crop the rate of approx 15 € /kg, is paid; in a poor seed year it is 30-40 € /kg. Seed collection would require 3-4 people over 3-4 days to collect all seeds.

The cost to process seed is estimated at 20-25 € /Kg. The selling price is on average 40 € /kg. (€30-45) but the price depends very much on quantities available and the demand in any year. In previous years, there was not a high specific demand for seeds from seed orchards or tested SO (better quality). Forest companies and landowners frequently looked for the cheapest available material. In general terms, there is a cycle of 3 years to produce a quality tree seedling from a seed orchard.



**Fig. 1** Sycamore seed orchard at Nidderau , Germany



**Fig. 2a**



**Fig. 2b**

**Fig. 2** Sycamore seed orchard at Nidderau, Germany. **Fig. 2a** Note seed clusters (arrows), **Fig. 2b** a dead tree (white arrow).

#### IV. Stop 2 Reinhardswald sycamore seed orchard (near Hann Munden)

- Area 1.0 ha; spacing 5 m x 5 m
- Establishment period was 1969 -1974; also present, seed orchards of ash, alder, pine, lime, D fir, Jap. larch The ash S.O. at this site is now badly effected by Chalara (dieback) disease with most trees dead or dying. The cherry S.O. at this site is over mature and non productive.
- Provenance source of sycamores: north Hesse at high elevation >400 m
- 21 clones some with wavy grain 'Riegelung' & some 'birds eye' grain
- Trees were very big and not managed intensively due to the low demand for seed in the years after seed production started, Fig. 3.
- The seed yield over several years is given in Table 1 showing the percentage of trees with seeds and the amount collected per year (kg).

Table 1. Yields of seed recorded from sycamore seed orchard at Reinhardswald

Seed yields recorded		
Year	% trees With seed	Kg Collected
1974	10	25
1975	25	80
1977	20	64
1978	15	48
1979	15	48
1985	20	64

From a management point of view, having these SOs far away from the main operation centre, has proven to be problematic for management purposes. For this orchard, tree re-spacing is the most important criterion to bring the trees into more fruitful production. In their experience, after 5 years a SO starts to be productive.

In addition to the sycamore seed orchard, there were 12 other seed orchards of different species in the area: *Betula*, *Ulmus*, *Pinus silvestris*, Lime, Japanese larch, alder, Douglas fir, Cherry and Ash. The ash seed orchard was badly affected by dieback disease (*Chalara fraxinea*) and the wild cherry was now too old and unproductive.

It is worth mentioning that this site of Reinhardswald Forest is part of hunting area with wild animals, mainly deer and pigs. Despite fencing, deer have been able to gain access causing considerable damage to some trees.





**Fig. 3.** Over mature seed orchard at Reinhardtswald note painted trees marked for felling (arrows) to make more space, leaving at least one ramet of each genotype after re-spacing.

#### **V. Stop 3 Nieste seed orchard (near Hann Munden, Kassel district)**

Planted in 1993, 1.8 ha, spacing 6 m x 5 m material from Hartz region, **Fig. 4**

- 107 clones variable number (1-16) of ramets /clone planted; the trees surviving were mostly <10 ramets /clone.
- very little seed evident in 2012—not a high yielding SO.
- trees of varying ages, some missing trees.
- trees need to be pruned and were possibly pruned once, in the early years.
- Loss of seeds may be due to frost at the flowering period. Site may be in a frosty area.
- Noted at establishment phase that grass competition was strong and retarded tree development.
- the forester planned to install a weather station to record the weather conditions during flowering.
- Seed yield recorded 2.1kg in 2002 and 14 kg 2004.





**Fig. 4** Large and medium tree in sycamore Seed orchard at Nieste note medium in-fill tree (foreground) and large original trees (background)

## **VI. General comments on seed orchards**

Many seed orchards were established from the mid 1970s to 1990s. The demand for Sycamore seeds declined in the 1990s as the seed orchards came into production and consequently the seed orchards were not intensively managed and maintained.

Interest in sycamore is now great in Germany. The research Institute of Lower Saxony has undertaken a major review of which species to develop for future needs. After a consideration of the potential importance (economic and environmental) of each species, sycamore was identified in Germany as having high priority for development among broadleaves. Consequently the existing seed orchards are being re-evaluated with the aim of re-spacing and selective pruning to bring more trees into seed production and to facilitate seed harvesting. Demand for 'Qualified' seed is high.

Due to pruning, the morphological appearance of trees in seed orchards (stem form, branching etc) is not an indication of the performance and morphology of their seed derived progeny.

## **VII. Visit to the seed processing centre: Hanau-Wolfgang, Hessen**

We were received by Mr. Lothar Volk. The work of the centre is on the processing of seeds mainly; organising seed collection, estimating seed yields and monitoring of flowering in seed stands and seed orchards. A consultancy service is also provided.

Seeds are processed, dried and stored according to the requirements of the species. Once dehydrated, large quantities of seed of conifers and broad leaves are stored at -5 ° C.

- **Sycamore seed handling**

Sycamore seeds may be collected in the colour stage of 'green' or 'brown'. The 'brown' stage is most reliable for handling storage and germination. Seeds are collected when the wings and seed are brown. These seeds may be dried to 28% moisture and are capable of being stored for 1-2 years with subsequent germination. Drying to 10% moisture kills the seeds. Germination is by bringing the moisture content to 35% by mixing seed in moist sand and stratification in this condition for approx 3 months before germination.

'Green' seeds are more difficult to define. Collecting seeds that have not turned fully brown i.e. too early results in no viable seeds. However if collected at the correct 'green' stage they may be sown directly in the Autumn of the collection year (without stratification) and germination will be good in the following Spring.

#### **VIII. Contacts for additional information:**

##### On seed orchards:

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## IX. Other items of interest

### *Deer resistant Norway Spruce*

Deer cause considerable damage to trees in the Reinhardswald Forest. Prof. Frohlich, Hann Murden (later Wiesbadan) made selections of N. Spruce germplasm with rough bark. We observed sensitive and resistant trees side by side, Fig 5. All of the sensitive spruce had deer damage, the rough barked spruce had none or very little damage.



resistant to deer damage in foreground, regular trees in background damaged (arrows)



**Fig. 6**

Engraved aluminium label on and expandable spring to permanently mark plus trees in a seed orchard

**Fig. 5** Rough barked N. spruce

### *Labels*

They use engraved aluminium labels with spring ties to mark each plus tree details in the seed orchards. Fig 6.

### *Anecdote on the forest at Reinhardtswald*

Long ago in the time of Robin Hood there was an equivalent German Robin Hood called Reinhardt, who robbed the rich to help the poor. He was eventually caught and sentenced to be executed but he was granted one last wish. His wish was to plant some trees in a seed orchard and to live to see them produce the next generation. He chose oak and he had a long life thereafter.

## **X. Acknowledgments**

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