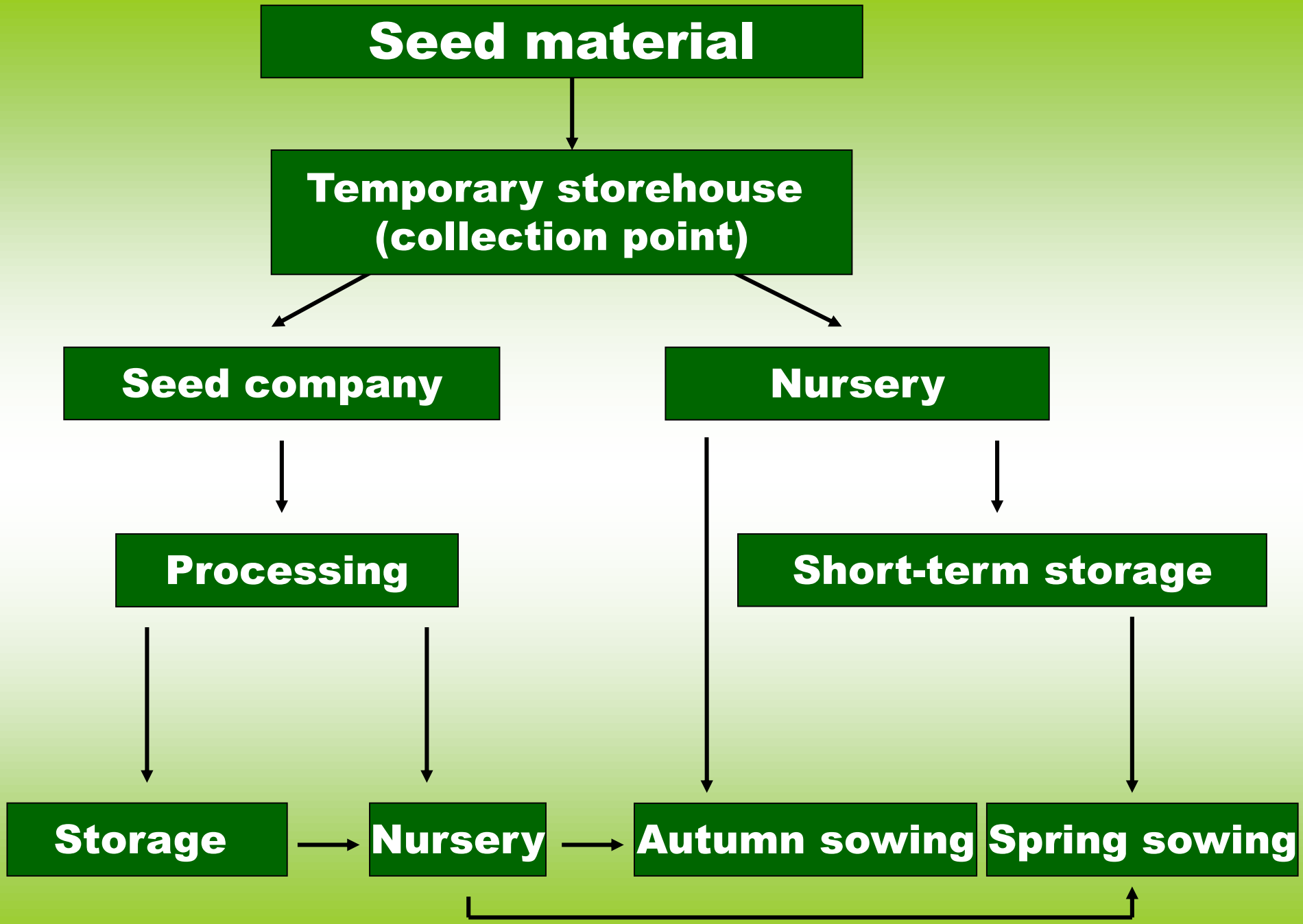

Handling and processing seeds
after collection


Seed material
Temporary storehouse (collection point)
Seed company
Nursery
Processing
Short-term storage
Storage
Nursery
Autumn sowing
Spring sowing

1. Temporary storage (storehouse of seed material)

a) Broadleaves with large seeds - *Quercus, Juglans*

- spread out (palm height)
- dry only on the surface

b) Broadleaves with seeds that germinate after a year - *Carpinus, Fraxinus, Tilia*

- after collection of green seeds - prevent drying or steaming up, sow immediately
- at full maturity - ensure gradual drying

c) Fleshy (pulpy) fruits – *Sorbus, Prunus avium,* Apple-tree, Pear-tree, shrubs

- transport for processing as soon as possible

d) Cones of conifers (Douglas fir, silver fir) and beechnuts

- ventilated areas, palm-height layer
- toss daily at the beginning

e) Cones of conifers – spruce, pine, larch

- **in sparsely woven bags, fill to 2/3, low layer bags, provide ventilation**

- **in low-layer on the floor in storehouse, toss according to water content**

Layer height and tossing frequency of seed material

Tree species	Hectolitre weight (kg)	Allowable height of cones layer (cm)	Tossing of cones at least
Pinus sylvestris	**more than 45** **40-45** **up to 40**	**30** **50** **80**	**once every 3 days** **once every 3 weeks** **once a month**
Pinus mugo	**35**	**25**	**once a day**
Pinus strobus	**more than 50** **up to 50**	**20** **30**	**once a day** **once every 2 days**
Pseudotsuga menziesii	**more than 30** **25-30** **up to 25**	**20** **35** **50**	**once a day** **once every 3 days** **once a week**

Tree species	Hectolitre weight (kg)	Allowable height of cones layer (cm)	Tossing of cones at least
Abies alba	more than 40 30-40 up to 30	20 35 45	once to twice a day once a day once to twice a week
Larix decidua	more than 35 30-35 up to 35	25 40 50	once every 2 days once every 4 days once a week
Picea abies	more than 35 30-35 up to 30	40 60 100	once every 3 days once a week once a month
Alnus glutinosa	up to 30	25	once a day
Alnus incana	up to 30	25	once a day
Alnus viridis	up to 20	25	once a day

2. Transport of seeds and fruits

- by train, by car, by post, air-conditioned cars
- danger of damage by steaming up or frost
- steaming up can be prevented by:
  - transporting dried seeds
  - shortening transport time
  - suitable type of packaging (not PE bags!)
  - tossing and aerating during transport

Principles:

a) cones (spruce, pine, larch) and **strobiles** (alder)

- bags 2/3 full
- laying on the floor - 1 m layer (alder 0.8 m)

b) seeds with higher water content (oak, beech, walnut)

- bags 2/3 full, in low layers
- laying on the floor - 40-60 cm layer

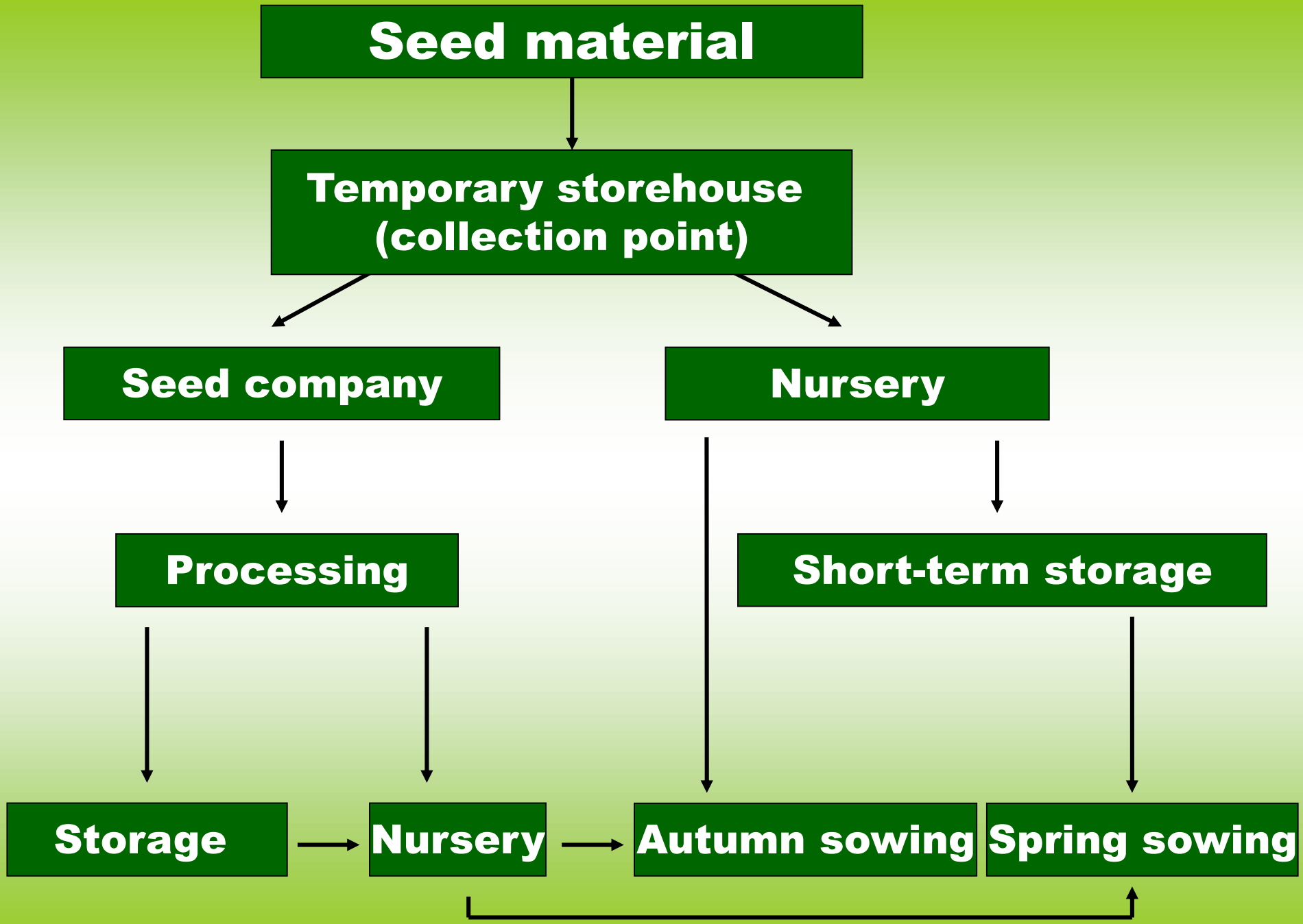
c) fleshy fruits (*Prunus*, Apple-tree, Pear-tree, *Sorbus*, shrubs)

- fast transport

d) stratified seeds

- baskets, crates with wet sawdust

b, d - do not transport under freezing conditions, or provide isolation!!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3. Seed material processing (seed plant)

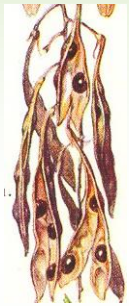
a) Obtaining seed <u>from dry fruits</u> of broadleaves

beech, oak, elm, *Acer, Fraxinus*

cleaning

Carpinus betulus, lime*, Robinia pseudoacacia, Laburnum anagyroides*

threshing



cleaning

b) Obtaining seeds from <u>fleshy fruits</u>

(*Prunus* sp., Apple-tree, Pear-tree, shrubs..)

mixer or press

↓

seed washing through a screen

↓

drying

↓

cleaning

c) Obtaining seeds from disintegrated cones
(*Abies alba, Pinus cembra, Betulus, Populus*)

self-disintegrating

or threshing

↓

cleaning

d) Obtaining seeds from undisintegrated cones
(spruce, pine, larch, Douglas fir, alder)

seed extraction

- sun extraction
- hot-air seed extractor
  - chamber
  - tunnel
  - floor
- mechanical seed extractor (larch)

dewinging

cleaning → **sorting**

Cone storage

Seed floor extractor

Gradual loss of water in storage

Seed extraction – 3 stages

pre-drying **30 °C**

↓

drying **40 °C**

↓

post-extraction **45-55 °C**

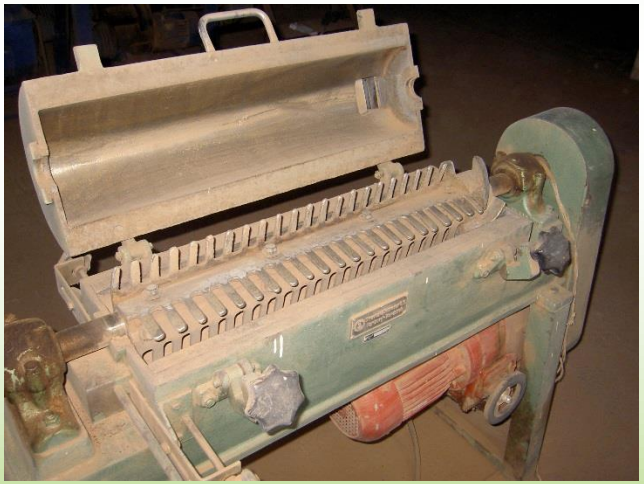
mechanic seed extraction
of Larix decidua
“Kaláb’s extractor”

Dewinging of conifer seeds

wet (*Picea abies, Pinus sylvestris*)

dry

lug wing extractor
brush wing extractor



Seed cleaning - sieves, blowers

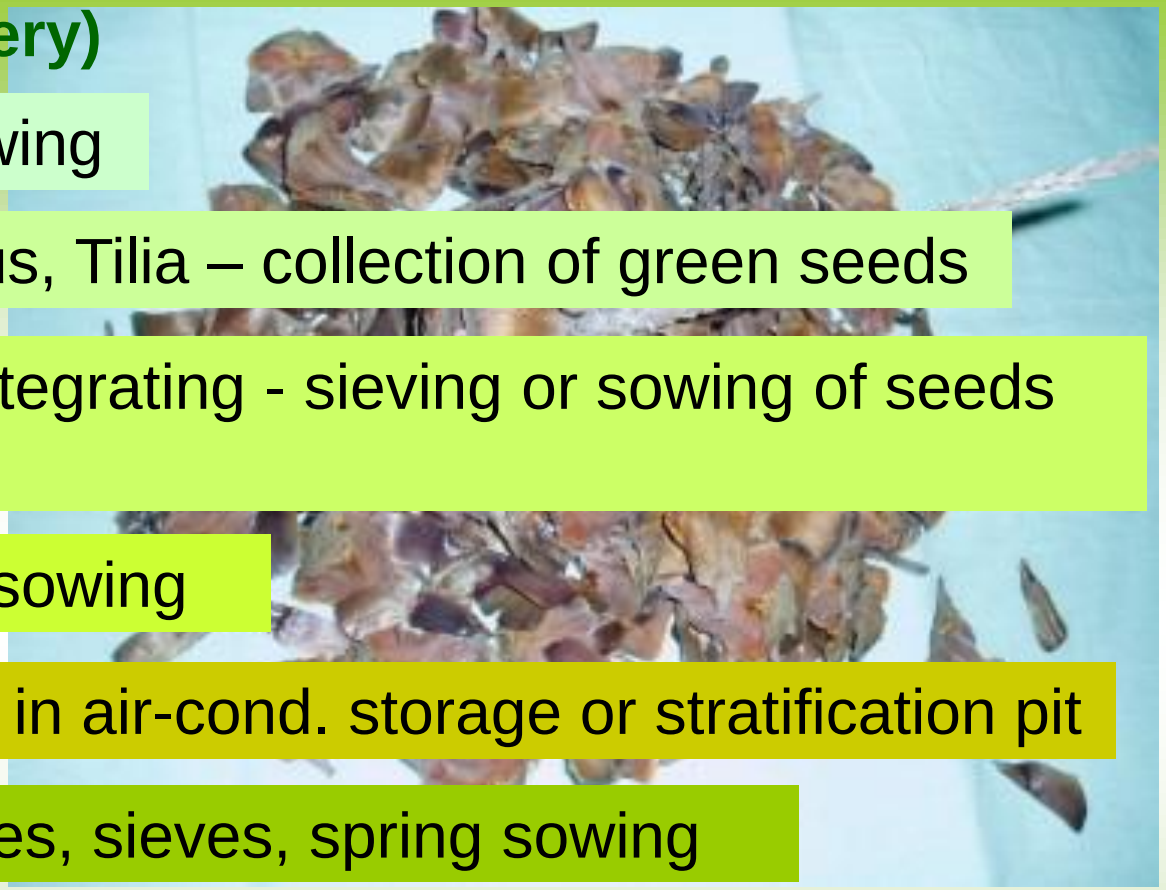
Petkus agricultural cleaner

BCC pneumatic cleaner

Seed sorting

- by absolute weight
- seed flotation

The following seeds are processed outside the seed company (in the nursery)



Ulmus – immediate sowing

Acer, Fraxinus, Carpinus, Tilia – collection of green seeds

Abies alba – cone disintegrating - sieving or sowing of seeds and scales

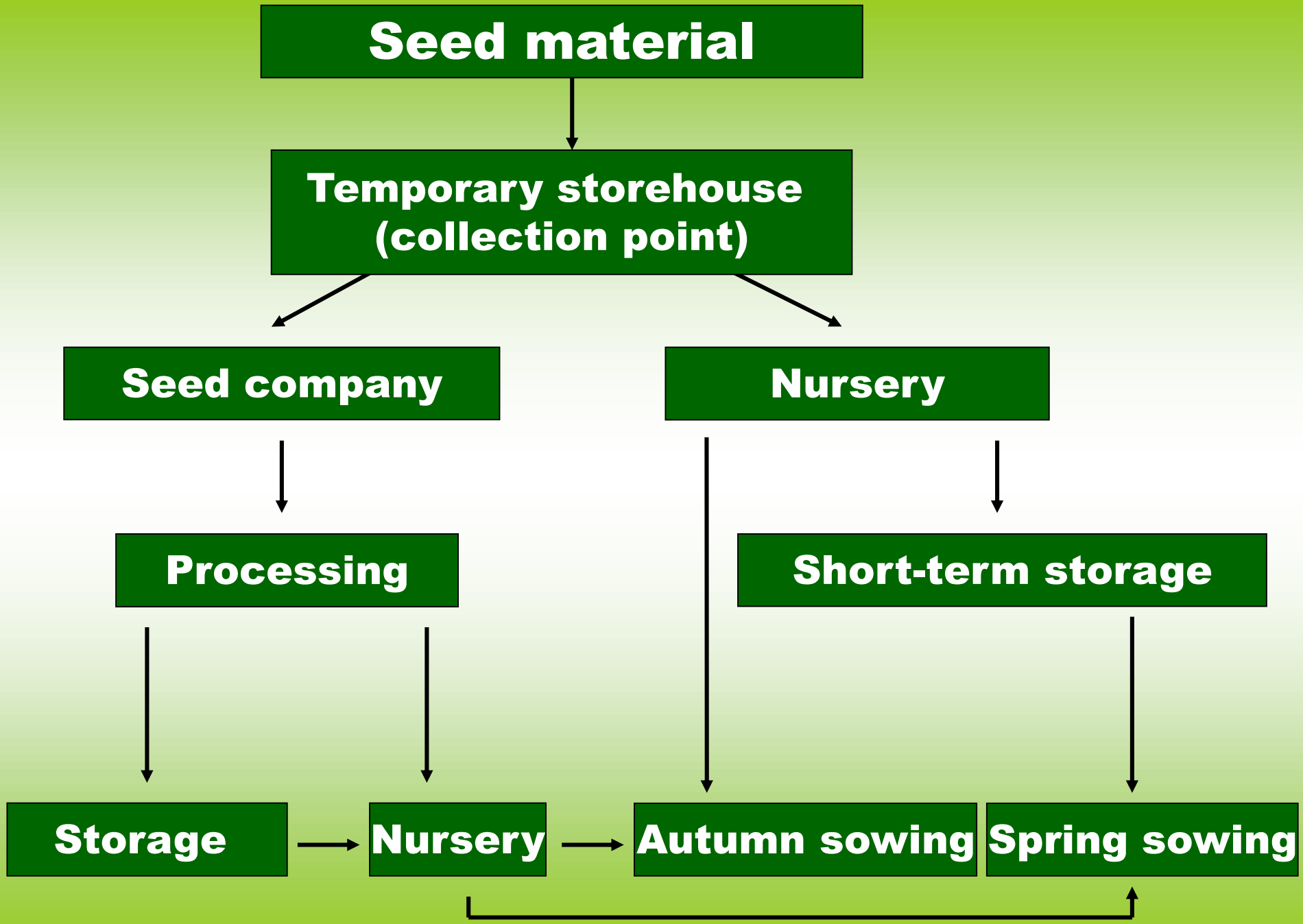
Acer – usually autumn sowing

Fraxinus – stratification in air-cond. storage or stratification pit

Alnus – opening of cones, sieves, spring sowing

Quercus, Fagus sylvatica

- autumn sowing
- beech stratification and spring sowing (beech and oak)
- sometimes thermotherapy in a seed company before sowing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1. Natural longevity of seeds

= the time during which a morphologically mature seed maintains its vitality (germination capacity) under normal conditions

Seeds

- **microbiotic** – up to 3 years (beech, oak, fir...)
- **mezobiotic** – 3-15 years (spruce, pine, larch...)
- **macrobiotic** – up to 15-100 let (Robinia pseudoacacia, Laburnum anagyroides...)

Natural longevity is influenced by:

a) heritable property

b) degree of maturity

Dependence of longevity of birch seeds at harvest time

Germination test	Germination capacity (%)	
	collection 20.6	collection 20.7
immediately after collection	57	87
1 year after collection	9	97
2 years after collection	0	79

c) external conditions

neighbourhood humidity

- the water content is not stable, the seeds create a **balanced humidity** with neighbourhood humidity

- current content of water in the seeds:
  lower critical
  (state of metabolic rest - anabiosis)
  upper critical
  (non-dormant germinating seed - biosis)

temperature

- affects metabolic processes rate and inventory breathing
- high temperature = seed death

air access

- critical for staying alive in some species, negative effects in other species

microorganisms

- degradation of reserves and formation of toxic products

2. Seed aging

= a complex of morphological, physiological and biochemical changes that lead through a gradual decrease of seed quality to their death

General manifestations (signs) of seed aging

- change of colour
- reduced tolerance to bad storage conditions and germination
- slower germination
- reduction to loss of germination capacity
- reduced growth and more abnormal seedlings

3. Seed storage

3.1 Theoretic aspects of seed storage

Objective: adjusting the conditions to induce anabiosis, slow down aging and extend the natural longevity of seeds

temperature reduction
reducing water content to a lower critical limit

- the lower critical water content is species specific
- two groups of seeds according to their ability to tolerate drying:
  - orthodox seeds
  - recalcitrant seeds

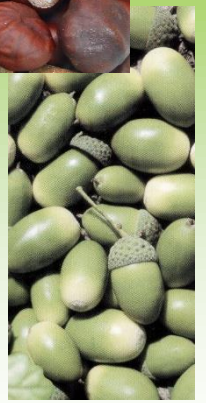
orthodox seeds

- drying over the course of maturation
- tolerant to reduction in water content to 5-10%
- can be stored under freezing conditions and without air access

a) true orthodox (spruce, pine, larch, birch, alder...)
storage duration 10 years and more

b) suborthodox (fir, beech, wild cherry, salix...)
shorter duration of storage

recalcitrant seeds



- no reduction in water content during maturation
- not tolerant to reduction in water content after shedding
- high critical water content (30-50%)
- not tolerant to freezing temperatures
- require air access

a) temperate (oak, sycamore, walnut...)
tolerant to temperatures as low as -2 °C

b) tropical
storage damage at 12-20 °C

The differentiation of seeds into orthodox and recalcitrant is the basis for choosing the appropriate storage method

3.2 Practical procedures for seed storage

(**Transient** – from collection to processing/storage/sowing)

Short-term – until the next biologically suitable period of sowing (through one winter)

Long-term – for a longer time, years

3.2.1 Storage of orthodox seeds

- short-term and long-term – air-conditioned storage
- long-term – accelerated aging test
- true orthodox seeds

  water content of conifers 5-7%

  broadleaves 6-10%

  hermetically enclosed bags

  temperature 0-3 °C

suborthodox seeds of *Abies alba*

- short-term - water content 13-15%
  - hermetically enclosed bags
  - temperature 0-5 °C

- long-term - water content 7-9%
  - hermetically enclosed bags
  - temperature -5 to -10 °C

suborthodox seeds of *Fagus sylvatica*

- short-term
  - water content 15-18% (up to 25%)
  - air-conditioned storage, cellar or natural conditions
  - 5-6 months, 3-4 months of which for pre-sowing treatment
  - temperature 0-5 °C

- long-term
  - water content 8-9%
  - hermetically enclosed bags
  - temperature -5 to -10 °C

3.2.2 Storage of recalcitrant seeds

deciduous: oak, sycamore, *Corylus avellana, Aecsulus hippocastanum, Castanea sativa*, walnut

require - protection against overheating (steaming up) and frost
- water loss prevention (recommended water content oak 45%, sycamore 35%, *Aecsulus hippocastanum* 45%, *Castanea sativa* 50%)
- air access
- limiting the development of fungi and mold

Short-term storage of acorns

- only in nurseries or sowing

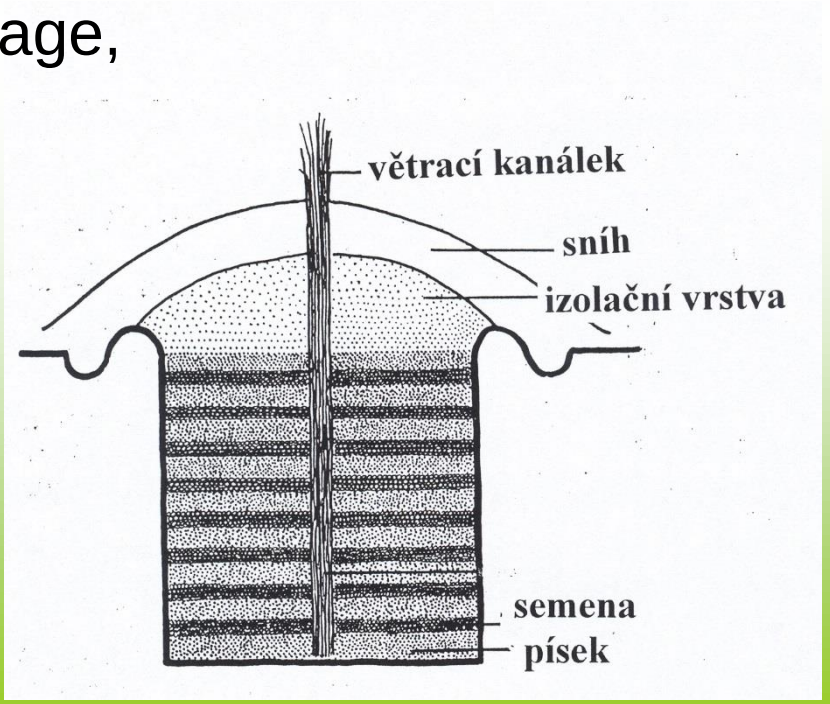
Cellars, air-conditioned stores

- 0-5 °C
- ! ventilation, humidity above 40%

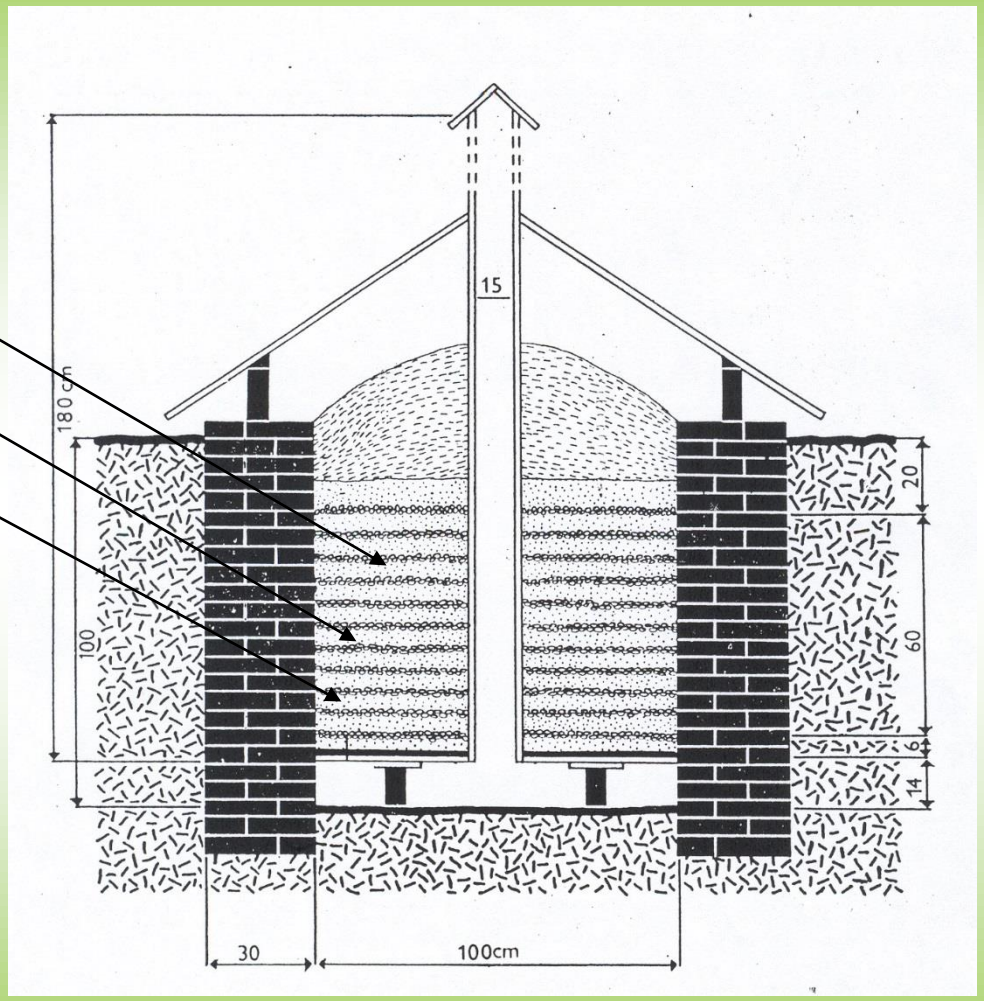
Sub-stand storages

- elevated point, isolation, drainage, rodent protection

Pits

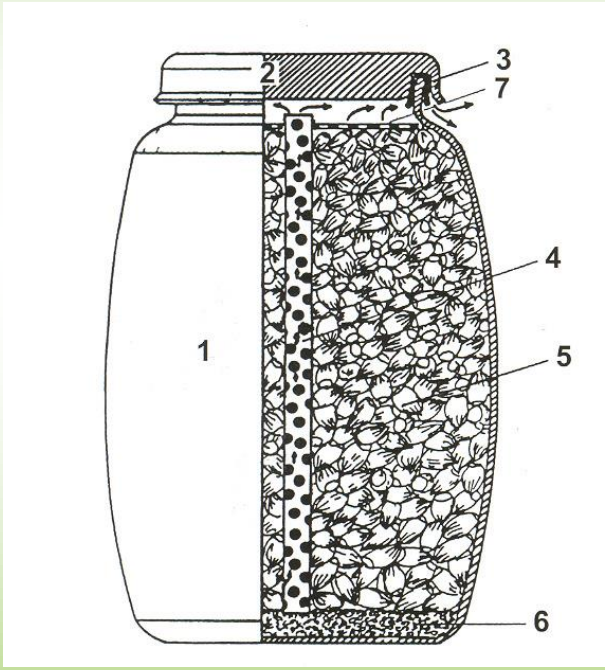


Storage units



Long-term storage

- flotation, thermotherapy and dressing
- air-conditioned storage
- water content at least 40%
- ventilation tube in a bag
- temperature max. -3 °C
- with or without a medium



Cryopreservation

- storage at extremely low temperatures (-135 to -196 °C)
- complete reduction of metabolism
  - by a lack of liquid water
  - by reducing the kinetic energy of molecules
  - reducing the rate of diffusion processes
- stops the biological aging of cells
- theoretically unlimited storage
- for seed and gene banks

Forest seed bank

- seed storage at (-18 °C)

1. for the establishment of seed orchards
2. for tests
3. for research
4. for international cooperation

Seed bank of regional forest tree populations at Forest of the Czech Republic

- to preserve/save the forest tree gene pools
- regional, endangered, rare or valuable populations

The National Bank of Seeds and Explants of Forest Trees (Forest research and game management institute)

National program for the protection and reproduction

of forest gene pools 2014-2018