



INVESTICE DO ROZVOJE VZDĚLÁVÁNÍ



Inovace studijních programů AF a ZF MENDELU
směřující k vytvoření mezioborové integrace
CZ.1.07/2.2.00/28.0302

**Tato prezentace je spolufinancovaná z Evropského sociálního fondu
a státního rozpočtu České republiky**

Perennial plants

- Asparagus
- Rhubarb
- Horseradish

Asparagus *Asparagus officinalis*

- Delicate vegetable, grown for
 - Blanched shoots: white asparagus
 - Non-blanched shoots: green asparagus (not so common)
- Direct consumption as well as canning
- For sale: early spring (mid-April), lack of other fresh vegetables



- Ancient Greece, since 17th century: spread worldwide, today: more than 150,000 ha
- Europe: Spain, France, Germany, Italy
- Czech Republic: town of Ivančice and surrounding area (2 ha), Mělník region (Obříství 8 ha)
- CR: suitable soil and climate
- Problem: high expenses concerning establishment of plants, profit starts to come only after three years of growing



Nutritional value of asparagus

- Dry matter 6-7 %
 - Fibre 1.8 %
 - Protein 2.2 %
 - Lipids 0.2 %
 - Carbohydrates 3.5 %
 - Vitamins (mg .1000 g⁻¹):
 - C 281
 - B₁ 1.4
 - B₁₂ 6.2
 - PP 10
 - A 3.1
 - B₂ 2.5
 - E 11.5
 - Ca 230
 - Fe 11
 - Mg 200
 - K 2,700
 - P 460
 - Zn 2
 - S 400
 - Mn 4.5
- (mg/kg of fresh mass)
- Asparagine: amino acid, promotes healthy kidney functions, helps eliminate foreign substances
 - Positive: low in nitrates

Botanical characteristics

- Perennial frost-resistant plant
- Generative propagation
- Robust root system
- Short root stalks with young shoots grow from root necks of the plant; these young shoots are eaten.



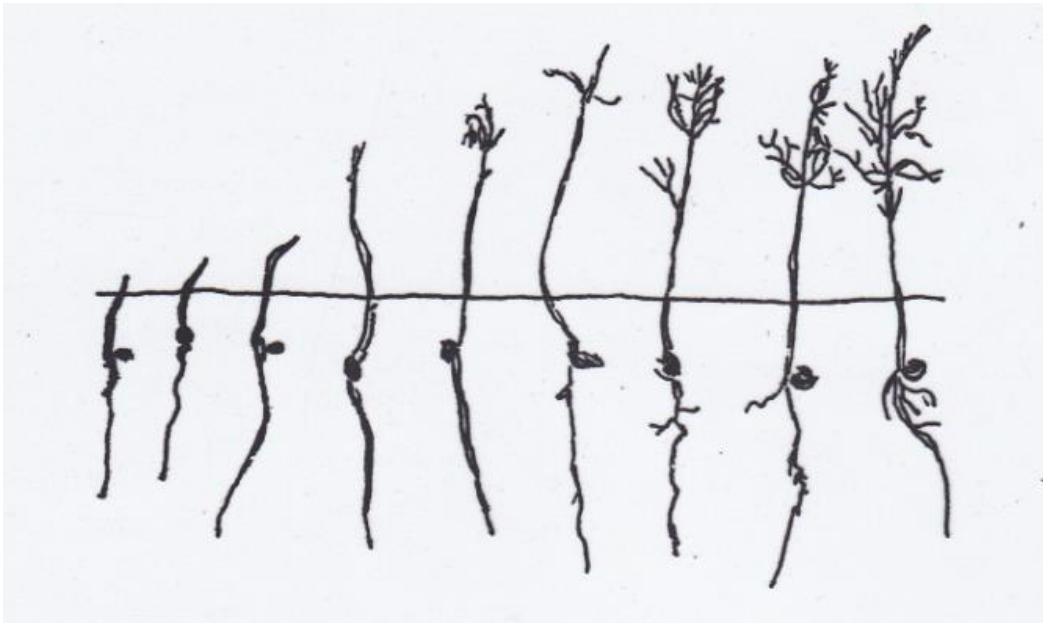
- Harvest: from April till 24 June (plant must bloom and produce seeds so that it may winter)
- Unharvested shoots grow up to 2m high branched stems with untrue leaves (flattened, green, assimilating phylloclade)
- Petite, bell-shaped, yellow-green flowers grow in phylloclade axils; dioecious plants ($\text{♀}:\text{♂} = 1:1$)
- Newly cultivated hybrids are purely male plants as they produce more shoots
- Fruit: green berry, turns red as it matures, 3-6 black seeds
- Shoots die in autumn, upper part of the root stalk becomes woody

Cropping practices

- Requirements: warm locations (for early harvest)
- Lighter soils, loamy-sandy, deep, rich in humus, pH 6.2-7.0
- Extra humus (optimum 2-3%)
- Humus concentrations must be adjusted at least 2 years before plantings with green manure or farm-yard manure (100 t per ha)
- Fertilization depends on farming intensity (8,000-18,000 plants per ha)
 - N 100 kg
 - P₂O₅ 100 kg
 - K₂O 200 kg
 - MgO 40 kg
- Precipitation in July and August determines next-year harvest

Seedling growing

- Seeds soaked in water are sown in April
- Peat flower-pots or mini-planting containers which are later planted in nursery
- Directly in asparagus nursery, exact sowing: 0.5 x 0.1 m, 3 cm deep
- Sowing standard: 1 kg per ha, plants are lifted in the autumn
- Coolers with 5-6°C, until spring

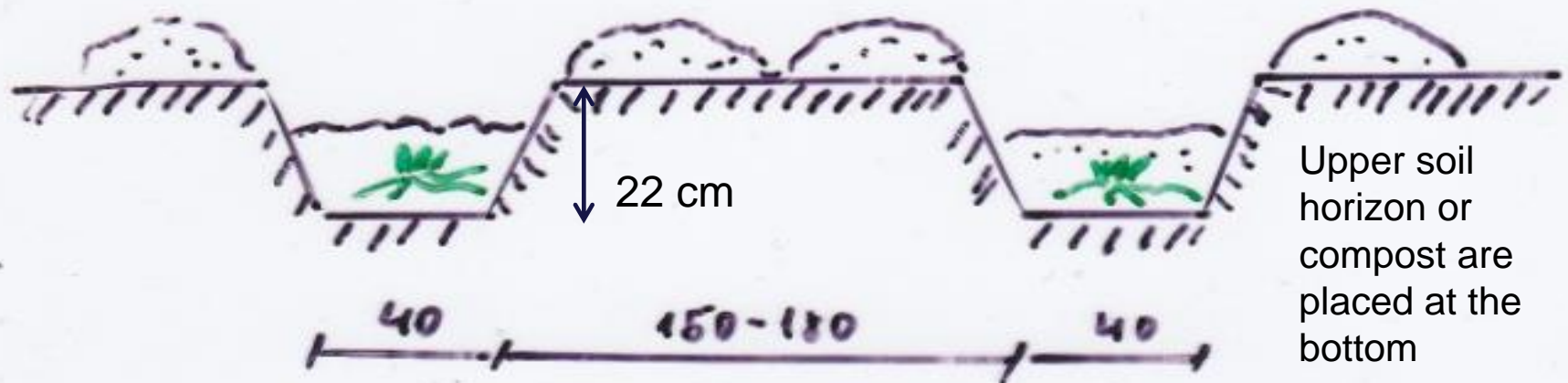


Asparagus root system in the first year (HEAD)

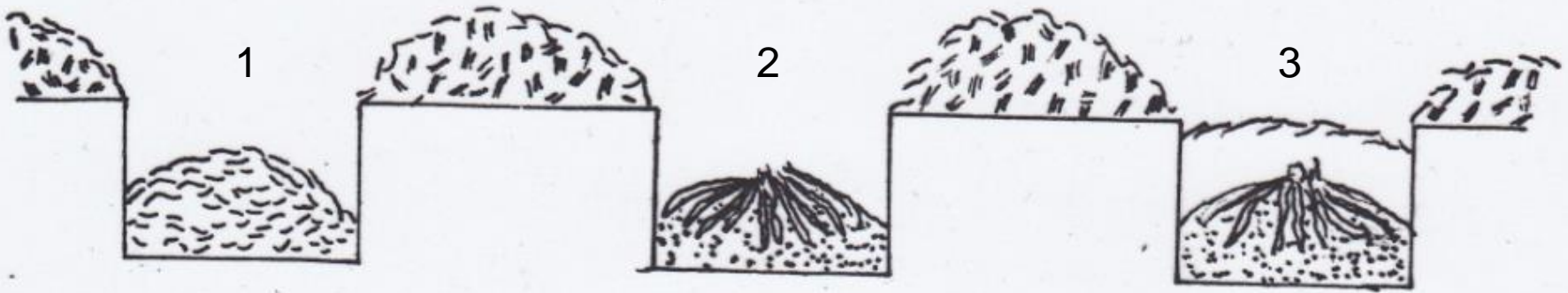


Seedling plantings

- Deep loosening of below-lifting soil layer (down to 0.7 m)
- Planting: end of March and April
- Large areas: special planting machines
- Small areas: manual planting
- Planting: 22 cm deep, plants 30 cm apart in rows, rows 1.8 m apart, plants covered with 5 cm of soil
- Irrigation, weed-elimination, protection from diseases and pests, removal of dry above-ground part



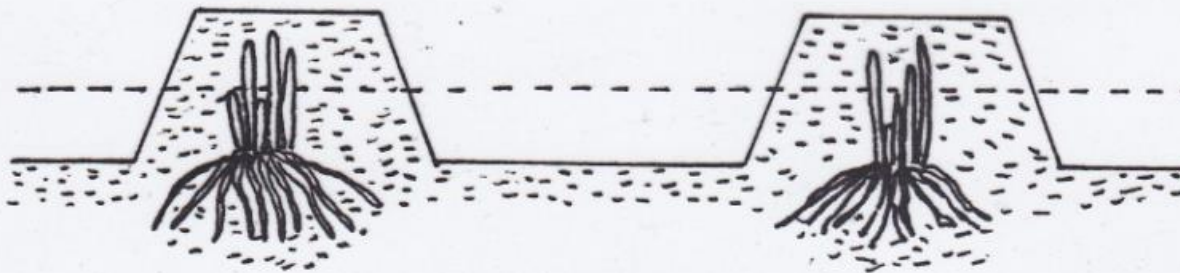




Planting of asparagus in furrows



Asparagus growing area in first year after planting



**Ridges up to
60cm deep, foil
sheets in April**

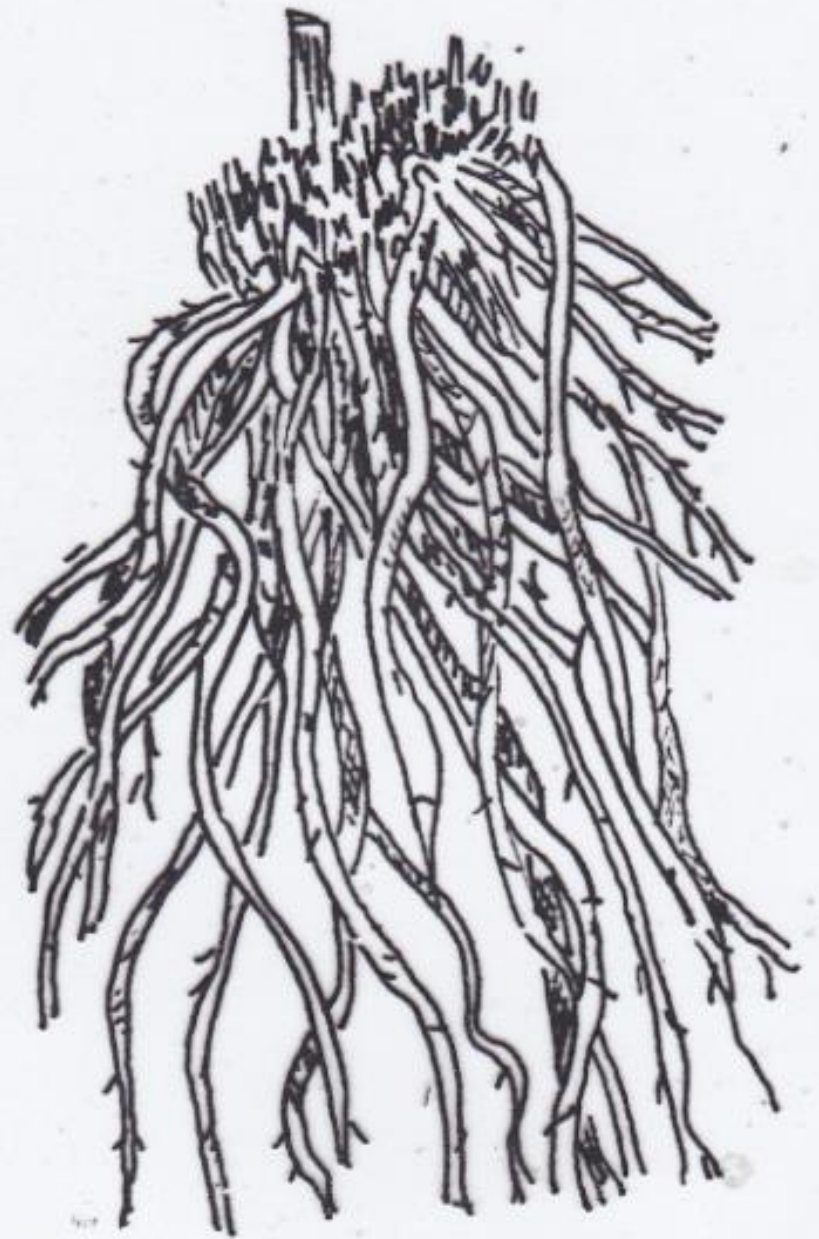
Modification of asparagus growing area in the third year after planting



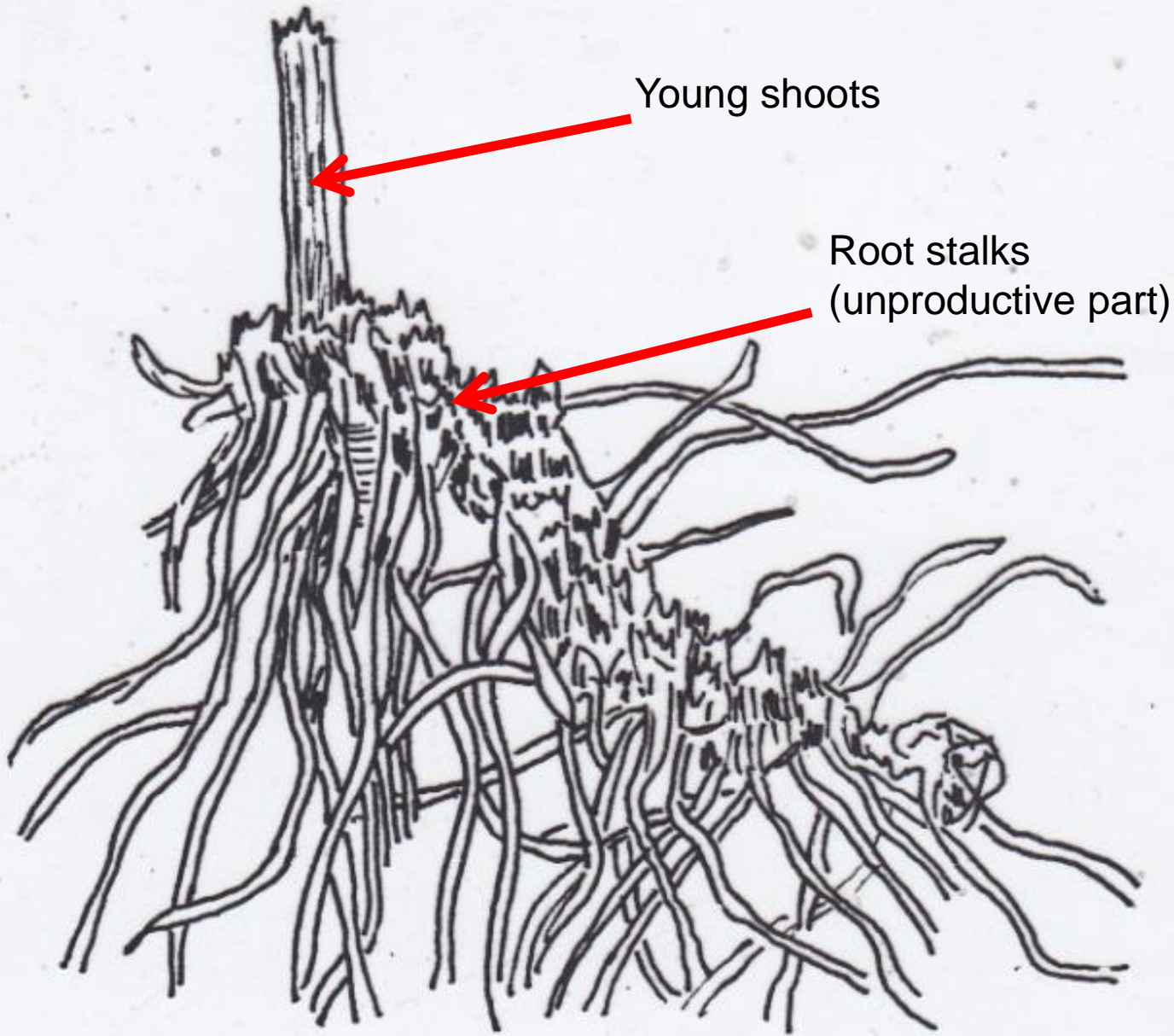
Asparagus at the onset of productivity



Well-developed one-year old seedling



Three-year old asparagus seedling



Young shoots

Root stalks
(unproductive part)

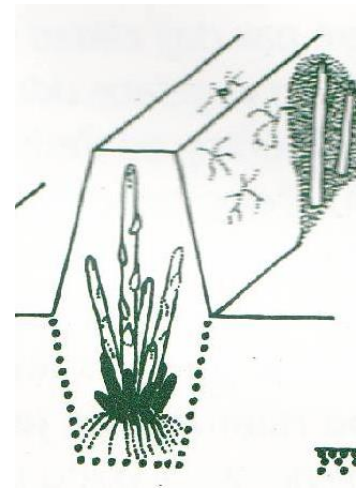
Six-year old asparagus (head)

Treatment after third year

- First and second year: no harvest
- Spring of the third year: removal of dry plant parts with cultivator or rotary tiller, hoe
- In March, half-round ridges (0.6m high) must be formed above the plants with special ridge forming machine or plough
- Black-white PE foil sheet is placed on ridges in early April
- Foil sheets prevent daylight from shining on asparagus heads, and heat up the soil (earlier harvest)
- Foil sheets are removed after harvest

Harvest

- Asparagus is harvested in third year after planting
- April through 24 June: early morning (3:00-9:00am), every day; uncovered plants: twice a day
- Foil sheet is moved aside and asparagus shoots are cut off with a special knife
- Hole from cut shoots is filled with soil, and ridges are evened and covered with foil sheets
- Asparagus is placed in baskets, and put in tanks with cold water in the field
- Cooling, transport to post-harvest line
- Performance: 5-10 kg per hour



Postharvest line

- Cleaning
- Shock cooling at 1-2°C water for 15 min
- Sorting, packaging into cardboards (filled with ice), or bundled (0.5kg)
- Dispatched to customers within 24 hours
- Storability at 1-4°C: max. 4 days
- Yield: 5-6 t per ha (1st year), after 7 years: 22-58 t per ha

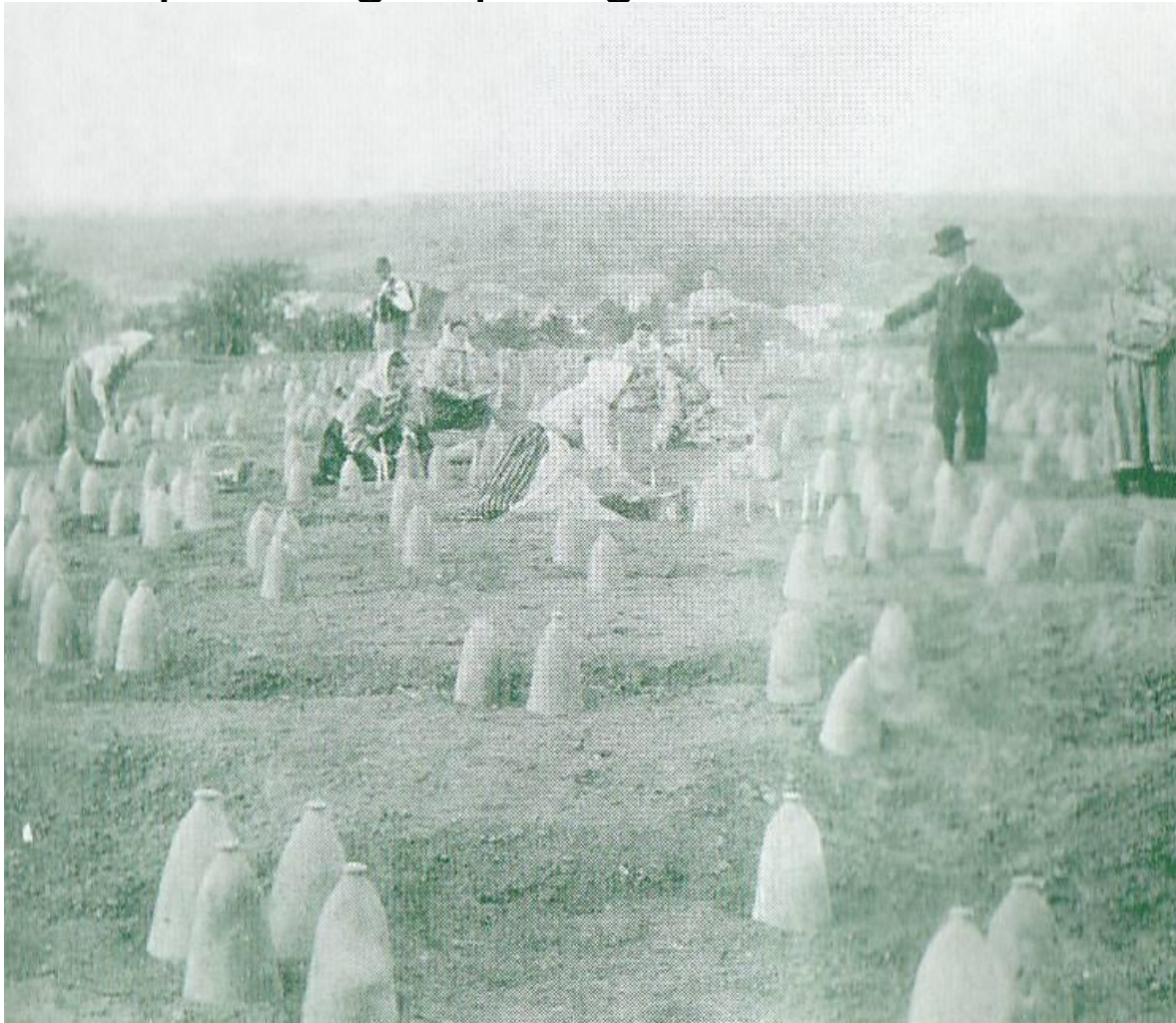
Sale

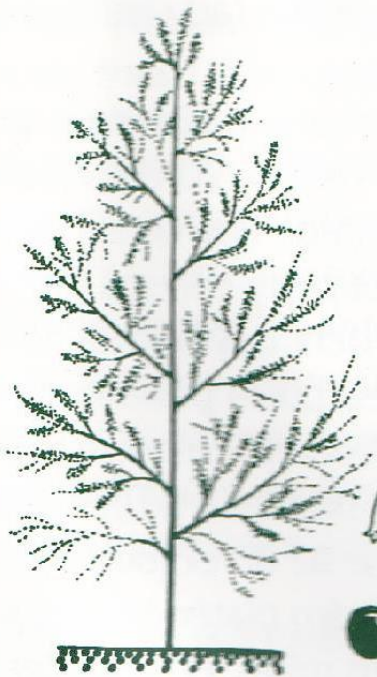
- VEGETABLE MARKET Frankfurt am Main
 - 1 kg of asparagus: 8-11 euro
- CR
 - 1 kg of asparagus: 60-80 CZK
- Goulash with asparagus and bread



Growing of asparagus in Ivančice region

- Special technology: asparagus was grown under special bells from burned clay (instead of growing in ridges) which were placed on sprouting asparagus

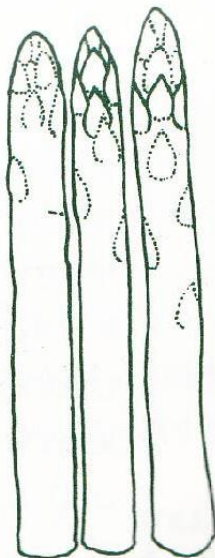




Rostlina chřestu



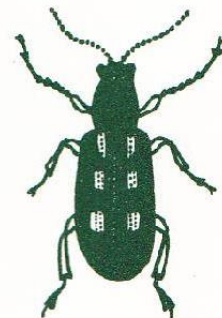
Detail květů
a plodů



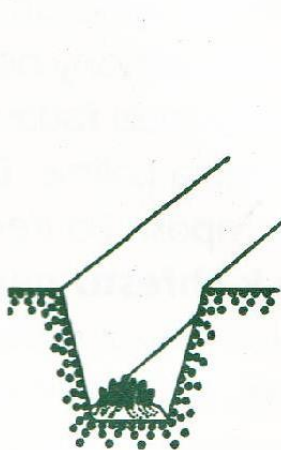
Pazoušky
světlého chřestu



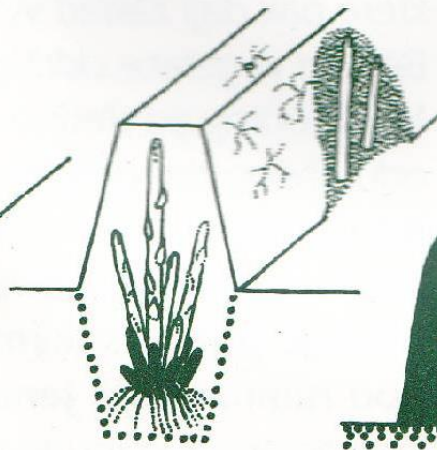
Pazoušky
zeleného chřestu



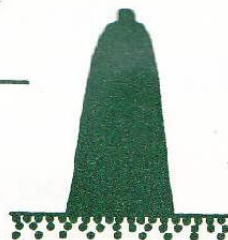
Chřestovníček
(velikost 5–6 mm)



Výsadba chřestu



Nahrůbkovaný chřest
v době sklizně



Chřest při rovinné
kultuře pod zvonem



Vrtule chřestová (5–7 mm dlouhá)
a pazoch provrtány jejími larvami





Rhubarb *Rheum rhabarbarum* L.

- Perennial vegetable, grown for petioles
- Harvested in spring (salads, juice)
- Origin: China, Mongolia, Siberia; used as a drug plant 2700 BC
- Used as vegetable in England and France in 18th century
- CR before WW II: Kralupy nad Vltavou region
- Today: Only for leisure gardeners



Nutritional value

- **Dry matter** 5 %
- Fibre 1.4 %
- Protein 1.3 %
- Lipids 0.1 %
- Carbohydrates 3.6 %
- Vitamins (mg .1000 g⁻¹):
 - **C** 100
 - E 2
 - B₁ 0.17
 - B₂ 0.3
 - B₆ 0.35
 - PP 1
- Oxalic acid (mg/kg of fresh mass)
 - 0.24 % beginning of vegetation
 - 3% at the end of vegetation (July)
- Ca 510
- **Fe** 19
- Na 147
- Mg 211
- K 2,500
- P 277
- **Zn** 3.9
- S 80
- Mn 1.3
- Cu 1.5
- **I** 0.08

Botanical characteristics

- Perennial plant, roots go 2.5 m deep
- Roots are long, pulpous, yellow-red; one or more growing tips
- Long leaves with petioles
- Robust, green, creamy and pink to dark red petioles

Low yield: red, fine petioles



- Flower stem: 1.5 m high, hollow, smaller leaves, inflorescence similar to panicle
- Blooming: May through June
- Fruit: brown triachene



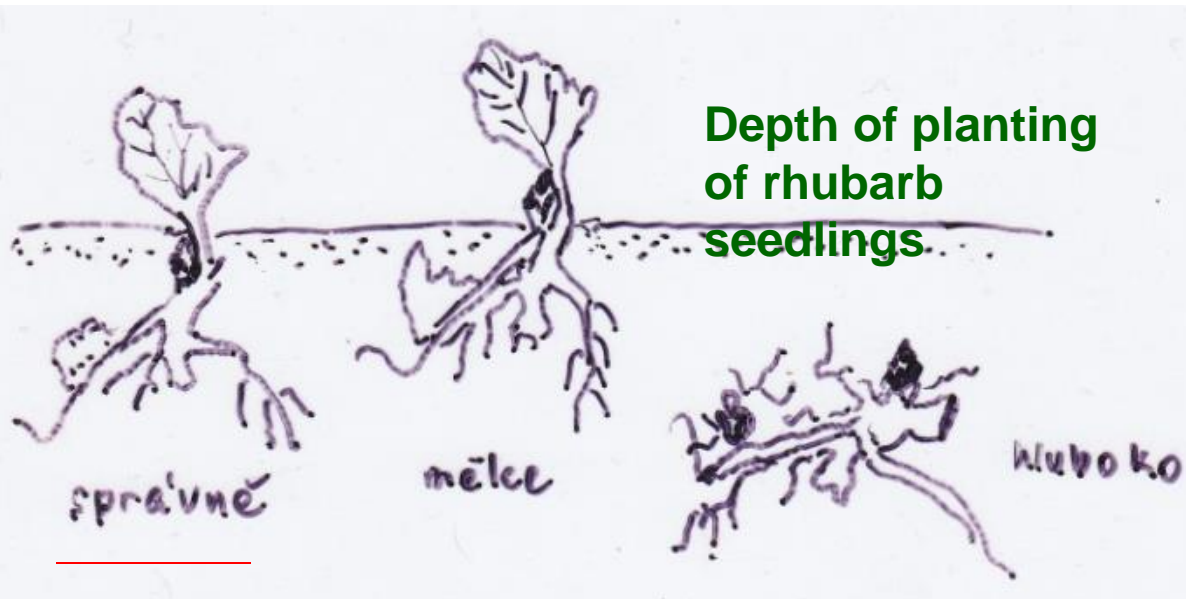
Cropping practices

- Low requirements on warm weather, but earlier-harvest crops should be grown in warm areas
- High requirements on irrigation throughout the year (750 mm)
- Deep soils, rich in humus and calcium
- Preceding crop: legumes, winter wheat, fertilized vegetables

- First year after fertilization with manure (40-60 tons of farm-yard manure per ha)
- Every 3rd year: 20-30 tons of farm-yard manure per ha
- Fertilization:
 - 260 kg N
 - 70 kg P₂O₅
 - 80 kg K₂O
- Unattractive for customers; for leisure gardeners only
- Generative propagation or division

Generative propagation:

- Seed sowing (right after harvest) in August or in hot-beds in spring
 - Spacing of pre-cultivated seedlings: 30 x 30 cm
- Planting: autumn or spring, furrows with spacing 100 x 100 up to 150 x 150 (rich, deep soils)
- Between rows: lettuce, bean, pea
- Space between rows is tilled in autumn, residues of leaves must be eliminated before



Vegetative propagation

- 3-6 pieces from 1 plant
- At least 1 undamaged bud on each part of the plant
- Planting season: September-October

- Harvest: 25 May through 20 July (in second year after planting out)
 - Petioles are harvested by breaking the leaves
 - First year of harvest: 3 leaves per 1 plant
 - Following years: 30% of leaves is harvested
- Adjustments of petiole:
 - Min. length for 1st grade quality: 250mm 2nd grade quality: 200mm
 - Cross diameter: 1st grade quality: 20mm, 2nd grade quality: 15mm
- Yield: 25-35 tons per ha, late varieties: 50-60 tons per ha
- Storage for 2 weeks: 1°C, 90% humidity
- Life: 10-12 years

Horseradish *Armoracia rusticiana* L.

- One of the oldest used plants, stimulating food, canning industry
- Origin: south-eastern Europe, western Asia
- In CR since 12th century, long tradition, not grown anymore in CR – difficult plant



Nutritional value of horseradish

- **Dry matter** **24 %**
 - **Fibre** **6.2 %**
 - Protein 3.9 %
 - Lipids 0.5 %
 - Carbohydrates 2.2 %

 - Vitamins (mg .1000 g⁻¹):
 - C 1,300** E 2
 - B₁ 0.17 B₂ 0.3
 - B₆ 0.35
 - PP 1
- (mg/kg of fresh mass)
- **Ca** **1,030**
 - **Fe** **21**
 - Na 210
 - **Mg** **240**
 - K 5,540
 - P 510
 - **Zn** **14**
 - **S** **2,100**
 - **Mn** **5**
 - Cu 2.3

- Essential oil: synigrin, spicy flavour
 - Grated horseradish: flavour and strength rapidly wither; synigrin is decomposed into mustard oil, glucose, and potassium sulfite
- Essential oils are of mustard origin: specific flavour
- Rich in peroxidase: oxidizes quickly

- Antimicrobial effect
- Helps digestion, cleans liver, regulates intestinal microbiota
- Cures dyspepsia - impaired digestion

- Excellent preservation agent: 3-4cm layer of grated horseradish is pushed in the mouth of apple-juice demijon
- Czech emigrants took Czech horseradish “Malínký” to the US, current name: “Bohemia”, top quality horseradish, oxidizes slowly

Botanical characteristics

- Perennial plant
- Strong, columnar root going several meters in the ground
- Roots are white to creamy inside
- Leaf rosettes with 0.5-1.2m long leaves with shiny blades grow from growing tips
- Leaves die in winter
- Flower stem: 1.5m high, panicle-like inflorescence, white blooms, no seeds

- Low requirements on climate, high air humidity and lots of precipitation, deep soil, rich in humus
 - Thin, dry roots in dry soil
 - Root rot in wet soil
- Vegetative propagation
 - Root cutting
- 5-10 mm wide
- Cutting: 22-25 cm long

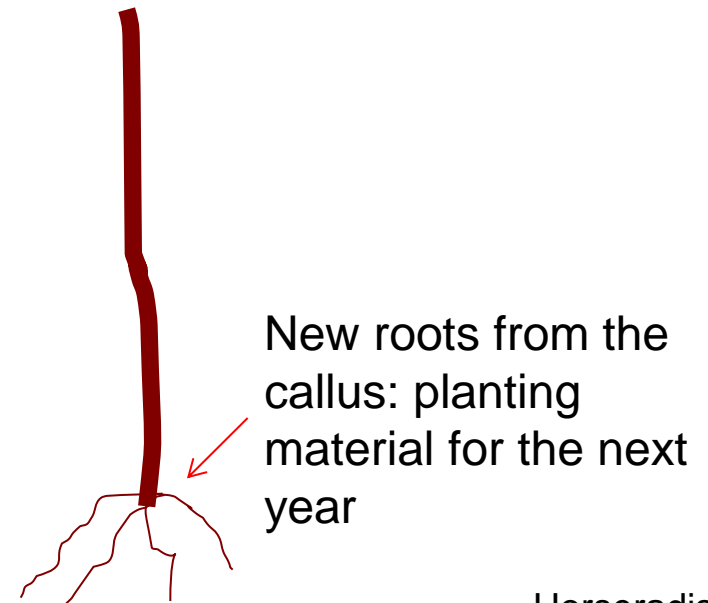
Cropping practices

- pH 6.5-7, deep soil with lots of humus and water
- 40cm deep tillage
- First year after fertilization with manure (40 t of manure per ha)
- Nutrients supplements:
 - N 40 kg
 - P₂O₅ 44 kg
 - K₂O 120

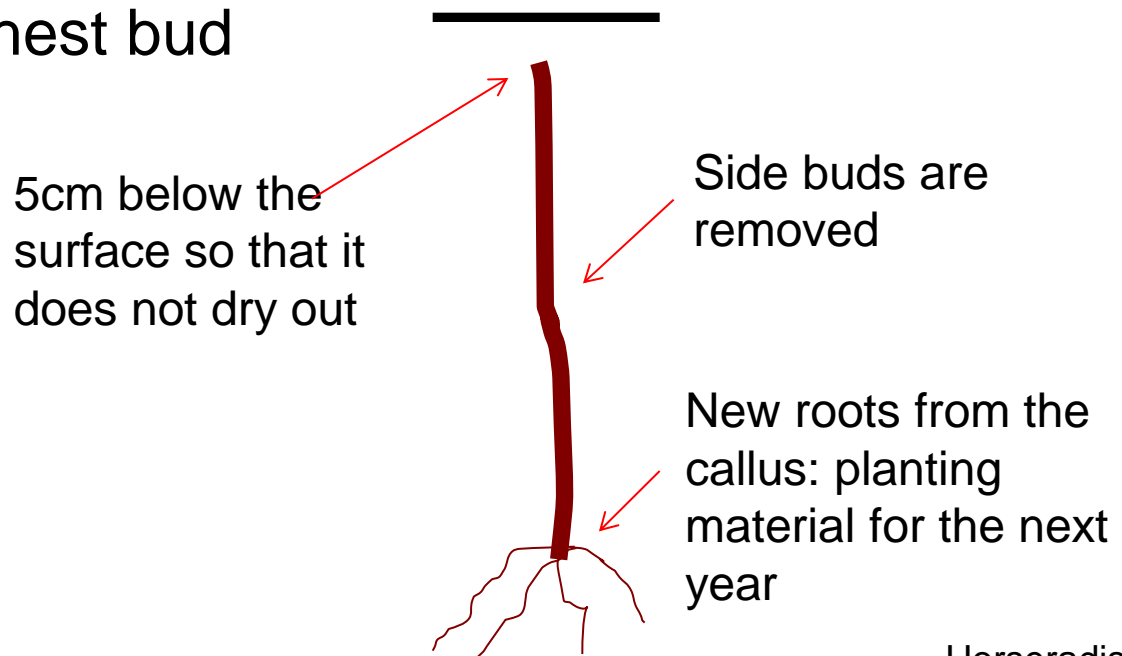


Annual cultivar for large-scale production (!)

- Planting stock is obtained in autumn from harvest of annual cultivars
 - Bottom roots formed from callus are 5-10 mm wide and 20-30 cm long
 - Apical part of the root is cut horizontally, basal part of the root is cut sideways
 - Roots are bundled and stored in sand over the winter



- Buds must be removed with coarse fabric so that the root does not branch and remains clean
- Spring (April): roots are planted in a well-processed soil
 - Sideways (45 degree) into furrows
 - 5cm deep in soil
 - Spacing: 50-70 x 25-30 cm
- Growing tip is the highest bud



- Root planted during vegetation grows to 2-3cm, uniform, identically long and strong roots
- Harvest: October/November, lifting (35cm deep so that there is plenty of long auxiliary roots for next-year planting)
- Roots are manually selected, cleaned and sorted
- Yield: 8-10 t/ha
- Storage: 0-1°C, 85-90% humidity, tolerates -4°C



Asparagus rust

Puccinia asparagi

- Asparagus leaves turn pale and yellow from July after harvest
- Brown patches of uredospore are visible in the centre of yellow spots
- Rust has negative impact on ability of the plant to store food reserves; yield may drop by 50% the next year
- Rust spreads very quickly
- Rust winters in residues of infested hay
- Residues should be combusted in the autumn, fungicides



Grey mould *Botrytis cinerea*

- Infested leaves are lighter and fall down
- Visible grey mould on sprouts
- Loss of assimilation area
- During harvest: damage plants as little as possible



Common asparagus beetle *Crioceris* ssp.

- Infest plants cultivated for seed
- Pupae winter under leaves, beetles come out in mid-May and eat above-ground parts of the plant
- 2nd generation (July, August) feeds on blooms and fruits
- Protection: burn and remove all asparagus residues in autumn; protect lady-bugs
- Strong infestation of asparagus



Horseradish virosis

- Negative selection
- Non-virus material propagation
- Meristem from growing point In vitro

Other vegetables

- Lepidium (green tops, brassicas)
- Sweet corn (grass)

Lepidium *Lepidium sativum* L.

- Green tops, good for soups and spreads
- Short-term growing
- Growing: outdoor; mostly forcing in semi-heated light premises
- Tastes and smells like horseradish
- Great for spring fatigue
- Brick-red seeds, taste like horseradish



Nutritional value of lepidium

- Dry matter 5.7 % (mg/kg of fresh mass)
 - Fibre 3.3 %
 - Protein 1.6 %
 - Lipids 0.6 %
 - Carbohydrates 0.4 %
 - Vitamins (mg .1000 g⁻¹):
 - **C 330**
 - **A 12.8**
 - **PP 10**
 - **E 7**
 - **group B**
 - Spicy flavour:
 - Glucotropaeolin and benzyl isothiocyanate
- Ca 500
 - **Fe 10**
 - Na 190
 - **Mg 220**
 - K 1,100
 - P 330
 - Cl 39
 - **S 1,700**

Botanical characteristics

- Produces fine plant with dissected leaves
- Grows up to 60 cm high
 - Harvested when 7 cm high
- Fruit: a silique containing red-brown, elongated, smooth, aromatic seed



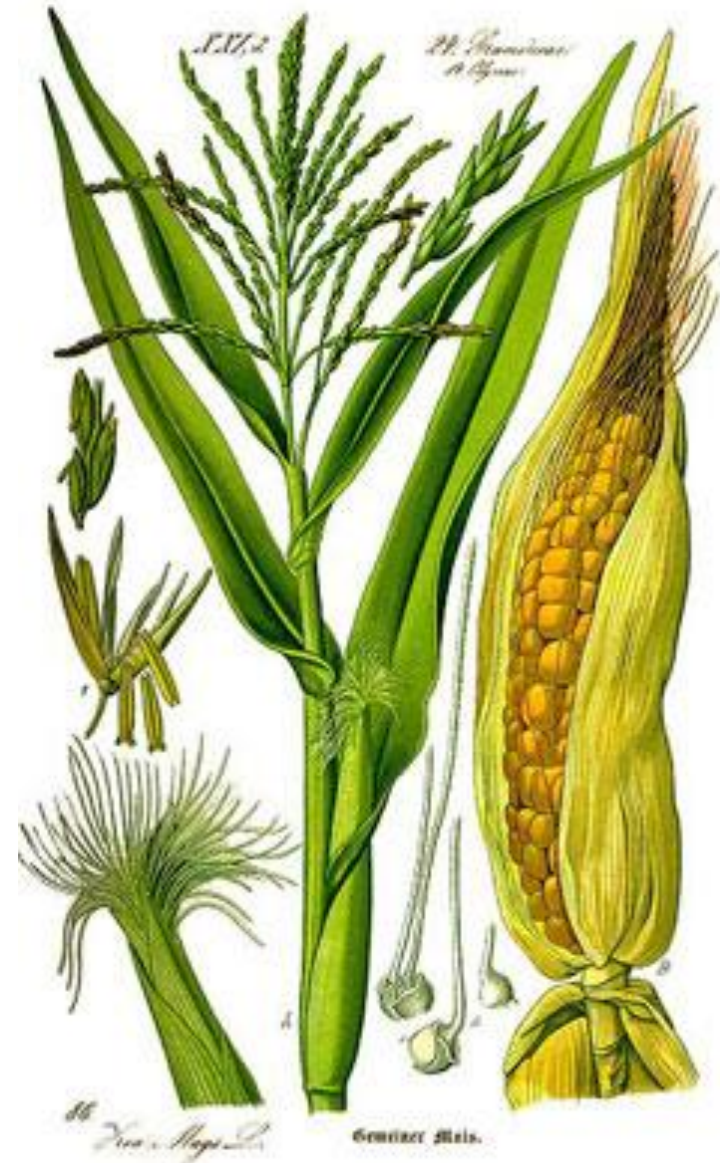
Cropping practices

- Least demanding vegetable
 - Harvest ripeness: within 7 days (7cm)
 - Seed ripeness: within 2 months
- Commonly forced
 - Sown in cellulose substrate (cotton-wool and water)
 - Single harvest, several sowings
 - Forced lepidium in winter

- Seedstock acquisition: sown in April, harvested in July
sowing standard: 20 g per 1 m² yield 100 g per 1 m²
- Germinating ability of seeds: 5-6 years 98%
- 1 g contains 500-600 seeds

Sweet corn *Zea mays* L. var. *sacharata*

- Origin: Central America
- Mostly grown in the US:
 - 12 kg per capita annually
- Europe: mostly in Hungary (30 varieties, canning)
- Monopole Czech producer:
Agromoravia Moravská Nová Ves,
500 ha



- Low-growing plant (1.2 m)
 - Max. height: 1.5 m
- Glassy, wrinkly seeds (compared to common corn, no surface is smooth)
- Grown for milk ripe seeds: frozen, sterilized; whole cobs are frozen; attractive for cooling plants
- Canned in brines (for salads) and sweet syrups (salads)



Nutritional value

- Dry matter 25-30 %
- Fibre 0.5 %
- **Protein 3.5 %**
- Lipids 2.3 %
- **Carbohydrates 18.8 %**
- Vitamins (mg .1000 g⁻¹):
 - C 66
 - A 12.8**
 - PP 19**
 - Pantothenic acid 7.3
 - E 5.9**
 - Group B
 - A 1.21

(mg/kg of fresh mass)

- Ca 80
- **Fe 6.6**
- Na 13
- **Mg 780**
- K 3,000
- P 559
- **Zn 4**
- Mn 2



Botanical characteristics

- Annual, monoecious plant, unisexual flowers
- Articulate culm, lance-shaped leaves grow from nodes
- Height: 80-130 cm
- Ears (male flowers) wrapped in leaf sheath grow from bottom leaf axils
- Male flowers form panicle at the top of the plant
- Caryopsis seed, 1 kg of seedstock contains 5,000 grains
- Less demanding on heat than corn grown for grain; grown in sugarbeet growing regions
- Germinates at 8°C soil temperature
- Grows at 10°C
- Pollination: at least 12°C
- High requirements on water



Sweet corn

Cropping practices

- Medium-heavy soil, rich in humus and nutrients
- First and second year after fertilization with farm-yard manure (heavy to medium feeder); low requirements on preceding crops, may be grown as one-species culture
- Fertilization:
 - N 150-180 kg in 3 doses
 - P₂O₅ 80 kg
 - K₂O 200 kg
 - MgO 50 kg
- Sowing: gradual, May through mid-June, 30-50 kg per ha
- Spacing: 0.72 x 0.2 – 0.3 Depth: 50-80 mm

- Harvested in milk ripeness
 - From July to mid-September
 - Fully mechanized harvest, post-harvest processing of ears in stationary line: grain is removed from spathes and dispatched to cooling plants or canning plants within 6 hours
- Yield: 3-4 tons of grain per ha
- Commercial use: yellow, non-cracking grains are required
- Botanical ripeness: seed is glassy, wrinkly