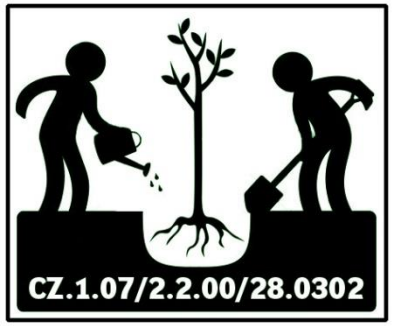
INVESTICE DO ROZVOJE VZDĚLÁVÁNÍ



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

- Cultivation of vegetables for seeds
- • Economically interesting sector of greengrocery
- – Necessary to have contracts with seed companies
- (Company usually supply seeds, methodology, etc.)
- • 2 BASIC METHODS OF PROPAGATION
- – Direct method of propagation
- – Indirect method of propagation

- Direct method of propagation
- • Seeds are harvested in the 1st year of growing
- • Seedling material is not removed in the autumn
- • Spacing must be larger during establishment of propagation stands
- Yes - early cabbage
- Can not be done for cabbage for storage – long vegetation period

- Indirect method of propagation
- • Harvest of seeds: 2nd year
- • Seedling material is removed in the autumn
- –negative selection: storage of plants that correspond with character of variety
- – Stored in spaces for seedling material
- • Frost-free basement areas with adequate moisture
- • Plants are stored:
- – in sand (carrot)
- – in peat substrate (cabbage, celery, Savoy cabbage)
- • Negative selection: more financially and labour intensive but provides perfect material
- • Problem of storage – grey mould

- Criteria of seed quality
- • Germinating ability – basic feature is quality
- • Cleanness
- – Dangerous admixtures – weeds
- (established for each type of vegetable – list of weeds)
- - In case of occurrence of unallowable admixtures (weeds), propagation stands will not be authorized during the show

- Weeds difficult to remove (unallowable admixtures) Lettuce - sow-thistle, foxtail
- Chive - barnyard grass, sow-thistle, field penny-cress, sorrel
- Cucumber - cereals spinach - smartweeds, bedstraw
- Parsley, carrot - sow-thistle, bedstraw, sorrel
- Onion - barnyard grass, knotgrass

Seeds production – seeds categories

Production of elite seeds (E)

- Seedling generation for production of elite seeds
  - carrot roots, cabbage head – edible part grown in 1st year is planted and in the 2nd year to bloom
  - Method that allows identification of characteristic varietal features in the technical maturation – negative selection
  - Reproduced in agro-ecological conditions for which the variety is cultivated
- Breeding station usually cultivates seeds (from seedling material)
  - Areas with optimal maturing of seeds – in the best conditions:
- CR
- Abroad – Asia, South America, etc.

Production of original (OR)

- Seedling generation for production of original seed
  - Seedling (mother plant) for seeds production in 2nd year
  - Managed for rational seed production in optimal conditions for achieving the seeds values
  - The highest possible seeds harvest, seeds for production harvest

- Breeding stations outsource seed propagation to seed producers
- If parameters of seeds are maintained: Stations purchase the seeds back from the producers
- Both in the CR and abroad (price)

Cabbage and Savoy cabbage for seeds

- Direct method – plants overwinter on fields (risky, winters without snow)

» Bigger spacing – bigger plants (form floral stalks)

- Indirect method – storage of seedlings in depositories
- Amount of seeds per 1 ha:

– Cabbage 160 kg
– Savoy cabbage 270 kg
– Brussels sprouts 80 kg

Production of seeds is low, high demands of human labour: reflected in price

- Direct propagation
- • Sown in stands, plants overwinter on fields
- • Danger of freezing: plants freeze at -10°C
- • Sowing terms – vital importance for overwintering
- – Overwintering – only plants that have developed leaf rosettes; plants with fully developed heads freeze
- late 10 June

mid-late 20 June semi-early 10 July early varieties 17 July

- • In spring: Plants will develop heads, crack and bloom

Indirect propagation

- Term of sowing:

– early varieties

- sown late in May and June
- so that the plants develop only 0.5 kg head till the autumn

– into spaces for seedling material

– late varieties

- Same term of sowing as for usual growing – April
- In the autumn: plough the row, hand pick – negative selection
- Plants into cellar or cooling chamber

– stored in sand or in peat – temperatures up to 10°C

- In spring: Planting from spaces for seedling material: deeper, together with a part of stalk (just below the head); this provides better anchoring of the plant in soil to prevent uprooting by wind
- Wider row spacing: early varieties 60 x 60, late varieties: 80 x 80
- Heads are cut (max. 2cm) to allow better growing through growing point

Grow. tip on stalk to prevent breaking

- Maturation: August – cut off floral stems, tie into bundles and place under the roof (for air flow – draught), sail under the plants captures fallen material. Necessary: quick and continuous drying to maintain good seed germinating ability.
- Growers are highly interested in good seed production –selection of the best

Causes of low seed production:

– Storage of material in inappropriate spaces for seedling material with considerable losses (former inappropriate establishment of seedlings, e.g. in hotbed)

– Inadequate use of irrigations: required especially in spring before seedlings root in the soil

– Losses influenced by inadequate protection against pests (weevils) and fungal diseases (alternaria blight)

– Excessive fertilization with N – thin tissues, uprooting, etc.

Cauliflower and broccoli for seeds

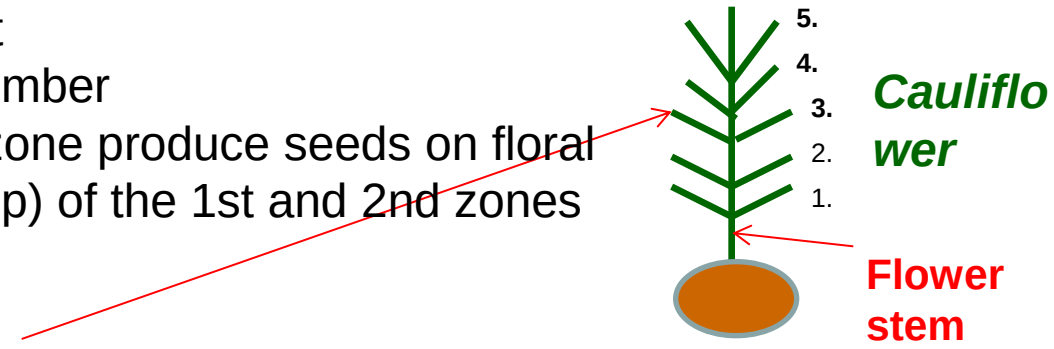
- Land
  - Appropriate: open location with calorific sandy-loam soils
  - Inappropriate: closed location with frequent fogs
- Preceding crop – fertilized vegetables except for brassicas, fertilized root crops, legumes
  - Plant isolation distance: 1,000 m
  - Medium feeder

Direct propagation

- Disinfect seeds in advance (Hermal, Promet, Pomarsol forte, Primicid)
- Sowing into boxes – to obtain strong plants
  - December
  - Beginning of January - only early varieties
  - Ambient temperature:18–20°C
  - After sprouting: 8–10°C (to harden up)

- Prick out in the stage of 1st true leaf
  - Into pots or into Jiffy pots (diameter: 7–9 cm, larger than ordinary seedling)
  - Steamed soil or substrate
  - Watering – solution of ammonium molybdate to prevent whiptail (Mo deficiency)
  - Spraying with Thiodan 35 EC 0.15 % against Swede midge
- Planting
  - In stage of 6-7 true leaves (about 2.5 months after sowing)
  - Until 15 April
  - Spacing 50 x 50
  - Until 20 June: Edible, compact head
- Good: medium-size heads only (chipping, losses)

- Negative selection
- Blooming: July – August
- Maturing: September
- Branches from the 3rd zone produce seeds on floral stem; apical meristem (growing tip) of the 1st and 2nd zones atrophy (dry out)



□□Cauliflower

– Metamorphosed inflorescences: there are no floral organs

– Heads do not crack, growing tip will develop on its own, no mechanic cutting

– Once the floral scape is formed, head turns brown and dries out

□□Broccoli

– Blooms normally, there is no metamorphosed inflorescence

– Basis of inflorescence is extended (by 10 cm), it is not so compact then

– – Every flower is a silique with 6-8 seeds

- Irrigation
  - Till the heads are formed: spraying, then water from drainage system
- Protection
  - Orange-sized heads: preventive spraying every 10 days: (in the morning / evening) • intensive chem. protection – increase in seeds revenues from 380 kg.ha-1 up to 800–1,000 kg.ha-1
  - Dithane M45 + Thiodan 35 EC (0.2 + 0.15%)
  - Pomarsol forte 80 WP + Fundazol (0.25 + 0.1%)
  - Ultracid 40 EC 0.1 %
  - Treatment against cabbage root fly is necessary
- Apply Furadan 10 days after planting (Use only for stands from seeds)

- Harvest
  - Manual
  - Cut off the whole flower stem
  - Final drying on open air (10–14 days)
  - Gradually filled into bags (limits of fallen material)
  - Threshing

Parsley for seeds

Direct propagation

- Sowing: end of May – beginning of July
- Good overwintering ability
- Blooms in 2nd year, seed matures in August – September
- Pull out and dry the whole plant, root will shrink
- Harvest of seeds: 0.8–1.8 t.ha-1
- The only danger – mice and rodents in soil (mousetrap – root of parsley)
- Germinating ability of seeds is max. 3 years!

– Problem of seeds in small packages

– Max. 70% germinating ability in 1st year

– Sprouting is even 20% lower

Carrot for seeds

Direct propagation (indirect is more preferable)

– Overwinters in stage of young plants

– Black frost (winters without snow): risk of freezing out (max. -10°C)

– Sowing:

• Late varieties June – beginning of July

• Early varieties end of July– beginning of August

– Spacing 0.4 x 0.2 m

– Blooms next year in June and July

– Matures in September

– Harvest: 0.4–1.2 t.ha-1

– Ribbed achene

Indirect propagation (more preferable)

– Sowing in March and April
– Negative selection
– Storage in spaces for seedling material (no green tops)
– March - planting of roots

• Plant isolation distance: 500 m

– Risk of wild pollination by wild carrot (yellow root)
– No umbellates around

• Weeds difficult to remove:

Goosefoots, sow-thistle, smartweeds, foxtail, bedstraw, sorrel

• Insecticides against carrot fly

Parsnip for seeds

- Direct (100% plant safely overwinter, high content of sugar) and indirect propagation (only for negative selection)
- Mice infest parsnip, but prefer parsley
  - Mice eat the root, and leave the head part with green tops (it is not visible)
  - Parsley is more nutritious - more attractive
- Spacing 0.4 x 0.4 m
- Harvest: 0.4-0.8 t.ha-1
- Seed: winged achene

Celeriac for seeds

Indirect propagation (elimination of hollow bulbs, negative selection) •

1st year:

– Sowing for pre-grown seedling – beginning of March

– Planting in May

– Negative selection – smaller, not hollow bulbs are better (1kg), (squeeze to find out if they are hollow)

– Storage in spaces for seedling material

• 2nd year

– Planting of plants from spaces for seedling material - April – spacing 45 x 45 cm

– Seeds mature at the beginning of September, dry out rapidly

– Harvest: 0.15–0.6 t.ha-1 (small seeds)

Small radish for seeds

Direct propagation

- Annual plant – after bulbs are formed, the plants bolt
- Plant isolation distance: 1,000 m (brassica)
- Sowing from March, April and May
- Spacing 0.3 x 0.3 m to 0.4 x 0.4 m
- Matures from June to September
- Seeds yield: 0.8-1.1 t.ha-1

Radish for seeds

Direct propagation

- Annual plant
- Plant isolation distance: 1,000 m
- Earlier sowing (April, May)
- Spacing 0.4 x 0.5 m
- Harvest August – September
- Harvest of seeds: 0.6–0.9 t.ha-1
- Germinating ability is good for 3–4 years

Black salsify for seeds

- Perennial vegetable
- Biennial / three-year plant; then seed production decreases
- Sowing in April – during the 1st year, only root is formed
- 2nd and 3rd year: black salsify blooms yellow - June
- Plant isolation distance: 1,000 m
- Matures in August
- Seeds production: 0.4–0.6 t.ha-1
- Bad germinating ability – only 50%
- For diabetics - inulin

Lettuce for seeds

- Pre-grown seedling, sowing – according to length of veg. period
- Spacing 0.5 x 0.25 m, cover with fabrics
- Plant isolation distance: 500 m
- Negative selection after formation of heads

(premature cracking, does not match the character of variety – colour,...)

- Seed production: 0.5–0.6 t.ha-1 (small, light seeds)
- Colour of seed is a varietal feature

– Shiny, silver-grey or dark brown

- Harmful admixtures - sow-thistle, foxtail

Spinach for seeds

- Sowing in April
- Spacing: 0.25–0.3 m
- Plant isolation distance: 1,000 m
- Blooms in May, June
- Matures in June, July, harvested with harvester
- Seed production: 0.8-1.5 t.ha-1 (heavy seed)
- Harmful admixtures: knotgrass, bedstraw

Tomato for seeds

- 2 negative selections

1. Colour of leaves and inflorescence
2. Shape of fruits and maturation

- Plant isolation distance : 100 m
- Lateral axes are not chipped: produce lot of fruits very quickly
- Harvest: fully matured fruits
- 1-2 days in wooden trough, no fermenting – otherwise loss of germinating ability, without watering -> may germinate
- Grinding of fruits: layers are blown out with fans, seeds remain
- No contact with metal objects – loss of colour (darkening) – no germination
- Drying of seeds in open air
- Seeds yield: 0.2–0.3 t.ha-1

Bell pepper for seeds

- Spacing: 0.6 x 0.3 m
- Plant isolation distance: 200 m from chilli peppers
- After harvest: chip off immediately, cut out placenta
- Soak for 6-12 hours into water

– Seeds are separated from the placenta

– Stir occasionally – seeds without germinating ability float, good-quality seeds sink to the bottom; spin

- Seeds with germinating ability: lemon-yellow colour; seeds without germinating ability: dark brown to black colour
- Seeds yield: 0.2–0.3 t.ha-1

Cucumber for seeds

- Plant isolation distance: 1,000 m
- Leave fruits on a plant (yellow to orange colour):
  - Cucumber 4-6 fruits
  - Gherkin 6-8 fruits
- Leave to soften, crushed into troughs + water
- 2-4 days at 16-20°C, (separation of pulp from seeds)
- Mix it, rinse
- Final quick drying in shadow, air humidity: 12–14 %
- Seeds yield: 0.3–0.6 t.ha-1
- Vacuum-packed seeds have the highest germinating ability in the 5th / 6th year (seeds may last up to 10 years), packed seeds usually have 2- / 3-year durability
- Only hybrid seeds

Melon for seeds

- Plant: 2-4 fruits (for the proper maturation)
- Seeds yield: 0.2–0.4 t.ha-1
- Technology similar to cucumbers

Chives for seeds

- Rows of 0.3 m
- Leave the best plants for seeds
- First harvest in 2nd year, then 2-3 more years
- Seed production decreases in other years and health condition is worse (rust)
- Harmful admixtures: barnyard grass, field penny-cress, sorrel
- Germinating ability of seeds: 3-4 years (usually packed)

Beetroot for seeds

- Indirect propagation – storage in spaces for seedling material in autumn
- Optimal size of bulbs: 10 cm, remove green tops manually
- Harvest of seeds: 0.8–2 t.ha-1
- Germinating ability is very good by 4th year, then declines
- Higher quality seeds are grinded for possibility of exact sowing

Onion for seeds

- Size of onion seedling – optimum diameter: 5-6 cm
- Planting in March – April (potato growing region)
- Blooms in July
- Matures in August
- Final drying with 10–20cm scape: about 1 month

(Seed must be able to absorb moisture from the scape)

- Threshing of seeds, cleaning of seeds
- Max. moisture is 16 %, otherwise threshing will damage seeds
- Yield: 0.4-0.8 t.ha-1
- Harmful admixtures – barnyard grass, knotgrass, gallant soldiers
- The best germination is in 1st to 2nd year (do not overstock with seeds)

Leek for seeds

- Cover with soil to protect from frost
- Lift the plants and place into spaces for seedling material
- Blooms in June and July
- Matures in August and September
- Threshing of seeds
- Final drying of seeds in temperatures up to 30°C
- Yield: 0.4–0.7 t.ha-1
- Germinating ability: max. 2–3 years

HYDROPONICS

- CR - South Moravia a.s., Tvrdonice 10 ha
  - Heat-exchanger gas station
  - Waste heat – previously only 1/5 of price
- Netherlands 400 ha, Germany 90 ha, England 100 ha
- Energy savings 20%
- Nutrient savings (fertilizers) up to 40%
- Higher purchase costs
- High demands on control technology
- High demands on staff qualifications (knowledge of mixing fertilizers, electrician – repairs of pumps, apparatuses)
- Problem – blocked intake in capillaries – plants wilt

Nitrogen

- In nitrate form, partly in the form of ammoniacal, about 20%

– In case of increased content of NH_4 - disorders manifested by chlorosis even at less sensitive species such as kohlrabi

- nitrate NO_3 – $CaNO_3$ calcium nitrate, potassium nitrate

– $NaNO_3$ is not appropriate for high content of Na

- ammoniacal – mainly DAM 390
- Today pre-mixed fertilizer solutions, plant intake nutrients, output water is analysed in order to find out what nutrients should be supplemented

PHOSPHORUS

- Phosphoric acid (also regulates pH)
- Ammonium phosphate, potassium phosphate
- PK-sol: a liquid fertilizer
- Maintaining P in solution causes problems: presence of high amounts of calcium salts at higher pH has negative impact - irreversible retrogradation

POTASSIUM

- Potassium nitrate
- Potassium phosphate
- Potassium sulphate
- Potassium chloride is bad: high content of chlorine:

Yellowing and loss of leaves (celeriac likes chlorine in the soil – but is not grown hydroponically)

MAGNESIUM

- Magnesium sulphate
- Kieserite is less appropriate - contains a certain share of potassium chloride (Cl)

CALCIUM, SULPHUR

- Usually not supplied separately
- Water contains certain amounts of these minerals

BORON, COPPER, ZINC, MANGANESE, MOLYBDENUM, IRON

- Salts: potassium borate
- Chelated form of Fe

pH

- pH 5.8–6.5
- For alkalization: potassium hydroxide
- For acidification: nitric acid, phosphoric acid, sulphuric acid
- Corrections 2x a day

Average daily consumption of major nutrients during vegetation per 1 plant (in mg)

TOMATO

- N 112
- P 43
- K 190
- Mg 21

CUCUMBER

- N 250
- P 75
- K 350
- Mg 26

Twice as high: huge assimilation area
Economically worse

Content of major nutrients in solution for vegetables (in mg.L)

- N 208
- P 62
- K 320
- Ca 180-220
- Mg 100

- Fe 3.5
- Mn 0.4
- Zn 0.2
- B 0.3
- Cu 0.2
- Mo 0.07

Laboratory inspection of nutrient content

Content of

- N ion-selective electrode and a calomel electrode or using colorimetry and phenoldisulfonic acid
- P colorimetry with ammonium molybdate using stannous chloride as the reducing agent
- K ion-selective electrode or flame photometer
- Ca on flame photometer or titration method with magnesium
- Mg can be determined separately using colorimetry and titanium yellow

HYDROPONICS GROWING TECHNOLOGIES

NFT

- **Growing without substrates** on thin layer of circulating solution
- Flow: min. 2 $L.min^{-1}$ (0.5 L reduces growth, and causes fruits shedding)
- Plants grown in trough made from polyethylene foil, 1% tilt (concrete trough and foil)
- Lower investment costs
- Possibility of transmission of diseases by circulating solution

Mineral felt (Grodan)

- First used in 1975 in Denmark
- Obtained by melting at 1,500–2,000°C
  – Basalts 60%
  – Limestones 20%
  – Coke 20%
- Binders are added into melted mass: bakelite and fillers, which increases absorption capacity of the fibres
- Pores constitute 17% of the total volume
- Weight 90 kg.m-3

- Single use of wool, wool used to insulate buildings
- Single use of nutritive solution supplied by micro-capillary to each plant, solution is not reused
- Excess of solution flows out of felt, not to interfere with other plants

Vermiculite

- Aluminium-ferric salt of silicic acid
- Original material increases volume by 10-15x at 900–1,100°C and gets porous structure

– Light, 1m3 = 120–130 kg

- High porosity
- Good water absorption
- Only for anchoring plants
- No longer used

Perlit

- Raw material of volcanic origin (rhyolite)
- Prevailing silicic and alkaline oxides (sodium, potassium)
- Processing of glasslike lumps at temperatures up to 1,000°C
- 1 m3 = 80–120 kg
- Much lower water absorption than vermiculite

- Affected by algae, tendency to flatten

- No longer used

Zeolit

- Produced by roasting of tufa deposits based on aluminum silicates
- Grey matter, small stones, brash
- High absorption capacity
- Disadvantage: high volume weight – heavy (800-900 kg/m3)

Use of rainwater

- Precipitation of 600 mm may provide a 1ha greenhouse with 6,000 m3 of water per year
- Sunny days: 5 L.m-2 per day, i.e. 50 m3 per 1ha per day
- Water from reservoirs could cover consumption of 4 hottest months of the year
- Necessary to adjust pH (acid rains, according to location)

Seedlings for hydroponics

- Sowing into perlite
- When cotyledon is formed, prick out into cylinders from mineral felt

– Felt is cut and the plant is placed into the cut area

Tomatoes

- The most beneficial culture in hydroponics
- Stem reaches 9–12 m deep, keeps growing; remove bottom leaves, part of the stem, after fruiting is finished, turns into a spiral, monoculture from February to beginning of December
- Yield: 1 m2 provides 45–50 kg of tomatoes
- Harvested in red-stage ripeness, varieties Long live: taste is significantly better than taste of tomatoes harvested in green stage
- Air temperature: 15–16°C requires 24°C solution
- Solution temperature cannot not drop below 15°C, otherwise Fe, P, Mg ion intake stops
- Temperature of solution above 28°C cause necrosis of fruits

Cucumbers

- 2nd most beneficial culture in hydroponics
- Growing: only 3-4 months –health condition deteriorates after that (powdery mildew, huge leaf surface, fungal diseases)
- 2 cultures can be planted consecutively in 1 vegetation period
- Harvest: 20–30 kg per 1 m2
- Worldwide trend: 20 cm straight cucumbers
- Air temperature cannot drop below 11°C
- Optimal temperature of solution: 28°C
- Higher air moisture: 85 %
- Daily check of nutrients in solution

Bell peppers

- Economically less favourable
- Only 30% yield compared to tomatoes – only 15 kg per 1 m2
- Plants are up to 2 m tall

Kohlrabi, lettuce

- Advantage – plant has RS in optimal temperature, we do not have to heat the whole greenhouse, just 10°C

- Optimal temperature of solution: 18–24°C

17°C solution may double the mass of the heads and accelerate formation of bulbs compared to the 8°C solution

- Lettuce appropriate for harvest – January and February – marketed as early as possible
- Not grown in CR