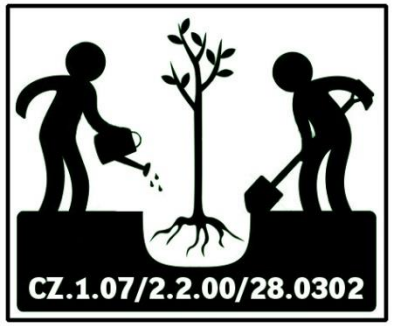
INVESTICE DO ROZVOJE VZDĚLÁVÁNÍ



Inovace studijních programů AF a ZF MENDELU
směřující k vytvoření mezioborové integrace
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Tato prezentace je spolufinancovaná z Evropského sociálního fondu a státního rozpočtu České republiky

Bulbous vegetables

Common onion

Shallot

Common garlic

Leek

- Used in cooking, as an herbal medicine esse bactericides
- Raw plants: used in preparation of spreads and mixed salads
- Low requirements for manual work
- Good storability
- Sales: throughout the year

Nutritional value g/kg mg/kg	ONION	Onion with green tops	SHALLOT	GARLIC	LEEK	CHIVES
Dry matter	120	95	102	305	123	147
Protein	17	20	17	66	25	33
Lipids	3	2	2	2	3	7
Carbohydrates	96	58	33	269	86	81
Ashes	5.8	12.9	6.2	13.5	11.3	17
Fibre	14	12	14	8	15	20
Calcium	420	850	240	510	86	850
Iron	6.5	21.5	8	12.5	76.1	89
Sodium	11.6	101	100	84	50	30
Magneisum	115	190	40	219	134	**440**
Potassium	1,680	2,350	1,800	4,360	2,250	4,340
Zinc	6.5	4	4	**11.3**	2.2	4
Sulphure	**740**	**500**	**510**	**300**	**232**	**484**
Copper	0.8	0.6	0.5	0.6	0.2	0.3
Selene	**0.01**	**0.01**	**0.01**	**0.02**	**0.01**	**0.01**
Iodine	**0.03**	**0.04**	**0.03**	**0.5**	**0.03**	**0.01**
Phosphorus	350	290	500	**2,590**	460	750
A	0.17	**10.7**	-	0.2	0.7	**20.3**
B_1	0.36	0.58	0.4	1.83	0.7	1.42
B_2	0.47	0.72	0.6	0.45	0.4	1.92
B_6	1.2	1.3	2	**3.8**	1.8	2
C	70	**372**	100	190	190	**664**
E	2	0.6	3.1	1	**20**	**16**

Common onion Allium cepa

- Origin: middle Asia, spread to Asia Minor and Mediterranean
- Historic discoveries about cultivation: at least 5000 years
- Prospects: growing area will decrease, consumption reduced due to changes in diet (less goulash with onions)

- Recommended intake: 9.2kg; actual intake: 9kg
- Among the most grown vegetables, **number 1 in the Czech Republic**
- Growing area in the CR: 1,700ha
- Good storability (until new harvest)
- **Yield** in the CR: 30 t/ha average, 50 t/ha attainable, 60-70 t/ha superior (Great Britain: 40 t/ha; developed countries: 30 t/ha)
- Wide range of colours and shapes (yellow, brown, red-purple, white)

- Good nutritional value
- Content of **phytoncides**:
  - Antimicrobial effects
  - Improves intestinal microbiota
  - Improves digestion
  - Reduces flatulency
  - Prevents cold

Nutritional value of onion

- Dry matter 12.1%
- Fibre 1.4%
- Protein 1.7%
- Lipids 0.3%
- Carbohydrates 1%
- Vitamins (mg .1,000 g-1):
- C 70 A 0.17
- B1 0.8 B2 1.2
- B6 0.4 E 2
- Ca 420 mg
- Fe 6 mg
- •Mg 113 mg

Botanical characteristics

- First, plants grow roots and leaves, bulb is formed after carbohydrates are accumulated:
  - Higher temperatures, longer days

- **Bulb is formed by thickening of leaves walls**
- If the plant enters into vernalization before the vegetation is over, the plant will bloom next year
  - In terms of seeds and growing: biennial plant
- Seed germinating ability: 1-3 years

- Bulb consists of corm

  -Corm is accompanied by tunics – basel plate surrounding one or more growing points

  – Flower stalk with inflorescence (2,000 androgynous flowers) grow from growing points the next year
  – Fruits: trilocular capsule with 2 seeds

Onion

Cropping practices

- Mid-heavy, humous, structured soils able to retain water
- Medium feeder, light feeder, humous soils (humus content: more than 3%)
- Intolerant to direct fertilization with animal manure
- Very susceptible to weeds
- Onions should be grown from seeds (!) Planting onion sets should be limited (leisure gardeners only)

Onion seeds

- Requirements on successful cultivation: good preparation of soil for planting

	Spring seeding (95% of all stands)	For wintering (winter onion)
• Sowing	March	last decade of August
• Harvest	July, August	May, early June (ALIX, HIBERNA, AUGUSTA)
• Sowing rate		
• Exact sowing:	2.5 kg/ha	3-4 kg/ha

30-42 x 8-10 cm (5 cm 70% germination: tables for sowing machine)

• Conventional method:		
	5 kg/ha	8-10 kg/ha
	(basically a suicide)	(winter killing: more than 25%)

Onions must have a proper germination of 80% and more! Germinate before sowing

- Sowing depth: 2-3cm (due to dry weather)
- Spacing: 30-42 x 8-10 cm
- Onions are sensitive to high concentrations of salts in soil

  - delayed application of fertilizers (!)
- Important: weed elimination (!)

  - Apply herbicides right after sowing

    -Lower yield, difficult lifting, extra drying, collection and sorting
- End of May: spraying against mould
- Requirements: 250-300mm precipitation per vegetation period

➢ Especially after sowing (!) (due to lack of snow in winter)

➢ During high peak of growth (June, July)

➢ Occasional irrigation after sowing of winter onion in autumn

- **Harvest** (mid-August, dry tops)
  - Lifting: half of the tops are lying flat
  - Extra drying: 7-14 days on field (tops dry out)
  - Collection (tops are removed on conveyors)
  - Onions are dried at storage plants on grids using warm outdoor air (layers up to 3m high)

    - Leisure gardeners let the onion dry on sun, 7-14 days (tops and roots must be dry)

    - Cut off tops, remove roots, store in boxes (12-15kg)
- **Storage: 0-3°C**

  at -1°C: susceptible to damage from pressure

  at -4°C: frost damage

  Critical temperature: 5-9°C; above 10°C: no more growth

Onion from sets

- **Planting**: in March
  - with a sowing machine (positioning of the bulbs is not guaranteed)
  - manually (leisure gardeners)
- Consumption: 1.1-1.4 t of onion sets per ha (1 kg = 25-40 CZK/kg)
- Sowing: not too deep in the soil, tops shoot from the soil
- Bulb: 0.5-1cm (bigger ones sprout)
- Earlier harvest, worse storability

Onion sets

- Grown from dense sowing in May-June 120-150 kg/ha
- Cautious fertilization with N
- **Harvest**: September – mechanical harvesting, drying in storage plants; cleaning and sorting
- 0.5-1cm bulb diameter (More than 1.5cm: risk of premature bolting)
- Immediate sale: growers do not store onion sets
- Prices right after harvest: 25 CZK/kg; spring: 40 and more CZK/kg

Economic comparison of onion cultivation from onion seeds and onion sets

	SEEDS	SETS
•Material costs	25,890	51,858
•Work costs	7,950	10,295
•Costs per 1 ton of production	1,700	3,057
•Price per 1 ton	3,100	3,050
•Total revenue	62,000	61,000
•Profit	+28 000 (yield 20 t)	-1,153

Reasons of low yield

1. Stagnation in implementation of new varieties
2. Improper preceding crop (root and tuber crops full of weed)
3. Quality and processing of soil
4. Irregular distribution of fertilizers
5. Failure to comply with timely and duely sowing (650,000-800,000 plants per ha)
6. Poor quality of seeds (loss of germinating ability)
7. Excessive fertilization with nitrogen (large quantities of bolting onions)
8. Failure to comply with storage quality

Welsh onion – *Allium fistulosum*

- Welsh onions are used throughout the year, tops are cut 3-4 times per vegetation, or the whole plants are harvested in very early stage as delicate onions
- Onion blubs: 1.5cm diameter, off-white colour
- Tops are used in soups, spreads, and mixed salads
- Onions winter easily, sprout in early spring (at 1°C)
- Onions may be left at the site for 4 years
- Onion do not suffer from rust
  (better than chives)
- Roots go 0.3-0.4m deep into soil
- Tops: vitamin C 400 mg%
- Not commercially grown

Cropping practices

- Sowing: 15 August (sprouts in autumn, and may be harvested in spring)
- Rows: 30-40cm
- Yield: 3-5kg/m2 of tops
- Cut manually

Shallot *Allium ascalonicum*

- Grown in Europe since 13th century, nowadays: mostly France and Poland
- Shallot has a milder flavour and **longer storability** than common onion (no sprouting and rotting)
- **Excellent storability** (2 years)
- Shallots are harvested as common onion in August
- Shallots should not be left in ground: tolerate -5°C only
- Auxiliary buds are formed in shortened growing point, and thus **5-15 bulbs** develop; bulbs gradually lose common tunic, and develop separately; however, they grow from a common corm.
- Elongated bulbs
- Very expensive seeds: 22,000-25,000 CZK/kg

Nutritional value of shallots

- Dry matter: 7.2 %
- Protein: 1.5 %
- Carbohydrates: 3.3 %
- Lipids 0.2 %

S 510 mg/kg
P 500 mg/kg
K 1,800 mg/kg
Ca 240 mg/kg

- Vitamins (mg .1,000 g^{-1}):

C 130 mg

E 30

PP 6

B_6 2

Propagation:

- Mostly vegetative propagation using bulbs from shallot clusters (Poland uses veget. prop. too)
- Generative propagation (very expensive seedstock: 22,000-25,000 CZK/kg of seeds)

- Planting of bulbs early in the spring in shallow holes in soil (bulb neck is above the ground)
- Shallots may also be planted in autumn, 5 cm deep in the ground

- 1.0-1.8 tons of planting stock per 1 ha
- Spacing: 0.25 x 0.1 m
- Yield: 2-3kg/m2, i.e. 20-30 t/ha
- Vegetation period: 110 days

Growing from seeds: bedding system

- 4 rows, 1.3m wide, or 5 rows, 1.5m wide
- 90 seeds per 1 m^2

Harvest

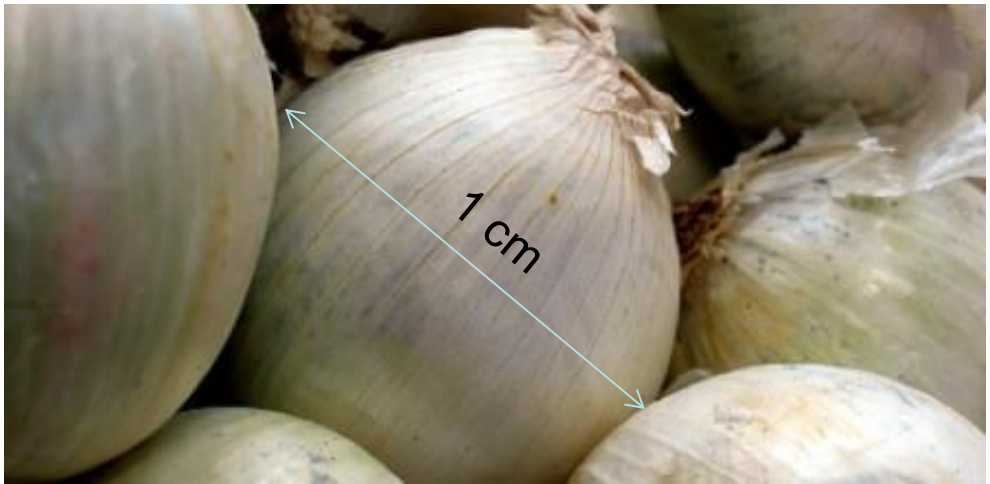
- Dry shallot bulbs are harvested in July
  - Storage requirements: shallot is harvested when tops are green and start to lay flat so that the shallot may be pulled out from ground easily without any loss

SPACING	SIZE OF SETS	YIELD kg/m^2
30 x 10	2 – 3 cm	2.35
30 x 20		1.25
30 x 30		1.05
30 x 10	**3 – 4 cm**	3.07
30 x 20		1.87
30 x 30		1.15
30 x 10	4 – 5 cm	2.80
30 x 20		1.73
30 x 30		1.38

Pearl onion *Allium ameloprassum* f. *holmense*

- Small off-set bulbs: 1-1.5cm, white, manual harvesting
- **Cannot be stored**: single layer of coats
- Processed in canning plants within 14 days after harvest, whole bulbs are pickled in sour-sweet pickling sauce
- Flat, upright, narrow leaves, similar to leek
- Slightly spicy flavour
- Content:

❑ 70% water
❑ 2.7% protein
❑ 5.8% sugar
❑ essential oils, main component:
allyl bisulphide



Cropping practices

- Planting: July, August (right after harvest)
- Spacing: 20-25 x 5 cm
- Planting depth: 5 cm (prevents freezing out)
- Harvest: only manual (small bulbs), early July
- Yield: 2- 3kg/m^2

- **Bulbs in clusters, 10-15mm**

- Unfit for storing
- Pickled pearl onions are imported from Poland

Chives *Allium schoenoprasum* L.

- Perennial, aromatic plant
- Wild plants grow all over Europe and in Czech Republic, too
- Economically uninteresting vegetable; profitable for seed cultivation only

- Chives make dense clusters of 20-30cm long, aromatic, prolonged stems which grow from simple, leather-like bulbs.
- Chives bloom in May and June.

Nutriční hodnota pažitky

- Dry matter 14.7 %
- Fibre 2.0 %
- Protein 3.3 %
- Lipids 0.7 %
- Carbohydrates 0.8 %

- Vitamins (mg .1,000 g^{-1}):

C 664 mg **A 27**

E 16

B_1 1.42 B_2 1.92

B_6 2.0

- Ca 850 mg
- **Fe** **89 mg**
- Mg 440 mg
- K 4,350 mg
- P 750 mg
- **Zn** **4**
- S 484

(/kg of fresh mass

Chives

Cropping practices

- heavier, loamy soils enriched with calcium and water
- pH 6.8-7.5

- **Precultivated planting material**: sprouts in light only

  Chives are sown in planting trays and containers (and covered with newspapers)

  Before seeds sprout, they are not covered with soil

  (Plantings are then pricked out into planting containers)

- Sowing: 10 April through 10 May, planting on field: 15 May through 15 June

  Spacing: 30 x 15 cm per 1 cut (develops into a cluster)
- Planting containers: January; February: clusters, 10-15 plants into pots

  - Propagation: division of clusters

Chives

Harvest

- **Manual** (demanding): chives are cut off with a knife, bundled, cooling plants
- Harvest using **cutter**: for drying only (Tvrdonice)
- Chives are harvested (i.e. cut) **5-7 times per vegetation period** when leaves are 10-15 cm long (longer tops bolt!)

- Chives are not cut the first year after planting so that they winter more easily without straw coverage (straw protects chives against frost)

- Chives require nitrogen and potassium

- Additional fertilization: 5 g of nitrogen per 1 m^2, after tops harvest

- Germinates at 4°C
- Field germination: 10-20 days
- Germinating ability: 1-2 years
- Seedstock: 8-12 g per 10 m^2

Leek *Allium porrum*

- Origin: Mediterranean, common plant in ancient Egypt
- Leek was not grown in the Czech Republic before due to low purchase prices
- Good for cooking: soups (dry leek), salads, main dish (in breadcrumbs, baked leek, etc.)
- Essential oils: antiviral effect, eliminate viruses in late winter (spreads, soups, etc.)
- Proper selection of varieties allow to harvest leek from July to late April of the following year (leek bolts late in the season)

Nutritional value of lee

- Drymatter 12.3 %
- Fibre 1.5 %
- Protein 2.5 %
- Lipids 0.3 %
- Carbohydrates 8.6 %
- Ashes 11.3 %

- Vitamins (mg .1,000 g^{-1}):
  - C 189
  - A 0.7
  - B_1 0.7
  - B_2 1.2
  - B_6 1.8
  - **E 20**

- **Fe** **76**
- Mg 134
- K 2,250
- P 460
- **Zn** **2.2**
- S 232
- Se 0.01
- I 0.03

(mg/kg of fresh mass)

- Typical smell and flavour thanks to essential oils
- Positive impact on liver and intestinal system
- Helps fight spring fatigue

Leek

Botanical characteristics

- In terms of seeds and growing: biennial plant
- First year: edible part of the plant: Thickened, elongated bulb comprising tight, blanched leaves forming the so called “stem”
- Number of leaves: 12-16
- Second year: 1.2-1.8 m long scape
- Bulky scape, 70-80 cm deep in the ground
- Seed germinating ability: 2-4 years
- Vegetative period of summer varieties: 120-160 days; winter varieties: 180-200 days

Wild leek – Allium porrum ssp. holmense

faster growth, longer edible part, plant does not winter

Leek – Allium porrum ssp. porrum

Longer vegetation period, shorter and wider edible, plant winters

Cropping practices of leek

- Leek is the most demanding plant out of all bulbous plants
- Heavy feeder, bulky scape demanding lots of nutrients and soil moisture, grown in sugar-beet growing regions, deep soils, pH 6.2-7.4
- Requires lot of nitrogen (120kg)

  60% of nitrogen: 70-90 kg before sowing

  30% of nitrogen: 40-50 kg after 4-5 weeks since planting or sprouting (N fertilizers with sulphates)
- P_2O_5 30-50 kg
- K_2O 140-200 kg (potassium sulphate)

- Leek is grown from precultivated planting stock (seeds are expensive) or directly from seeds (not so expensive, if domestic varieties are used)

	SUMMER CULTURE	AUTUMN CULTURE	WINTER CULTURE
sowing	**Dec – Jan**	**Early April**	**End of April**
planting	Early April	(Early June)	(end of June)
harvest	June - Sep	Oct – Dec	Mar - Apr
	No wintering, freezes out	Tolerates-10°C **Wintering**	Tolerates-15°C, **Wintering**

Leek

Planting:

•Planting furrow 10cm deep, plantings are planted at the bottom (blades and roots are cut to half, which prevents harmful evaporation)

•Planting furrows with plants are covered

•Autumn and winter varieties: plants: white stem can be blanched by gently drawing up dry soil around the stem

Exactly performed sowing:

- Well-prepared soil, 2-3 kg/ha, 270,000-300,000 plants per ha
- Spacing
  - Summer cultivars: not covered with soil, 0.3 x 0.1 m
  - Winter and autumn cultivars: 0.5 - 0.7 x 0.1 m (plants are covered up with soil)
- Sowing depth: 3-5cm

Harvest

- Mechanized: harvesters

  Plants are lifted; soil is removed
- Smaller growing areas: manual harvest using forks

Storage

- Winter and autumn cultivar: -2°C, 3-4 months
- Summer cultivars cannot be stored, direct consumption only

Garlic *Allium sativum*

- Origin: Central Asia (Kyrgyzstan, Tajikistan, Uzbekistan)
- Garlic has been grown for thousands of years, one of the oldest cultivated plants (seasoning, smoked food, medicines)
- Edible part: combined bulb with cloves

- Consumption CR: 0.8 kg per capita annually
- Average yield: 6.17 t/ha
- Cultivated area: 2000: 1,400 ha
  2010: 63 ha (China)



Nutritional value of garlic

- Dry matter 30 – 35 %
- Fibre 0.9 %
- Protein 7 %
- Lipids 0,2 %
- Carbohyrates 25 %
- Ashes 1.4 %

- Vitamins (mg .1,000 g^{-1}):

C 92 PP 6

B_1 1.13

B_2 0.44

B_6 3.8

- Ca 310
- **Fe 12,7**
- K 4,360
- P 1314
- Mg 219
- **Zn 11.3**
- **S 700**
- **Se 0.05**

(mg/kg of fresh mass)

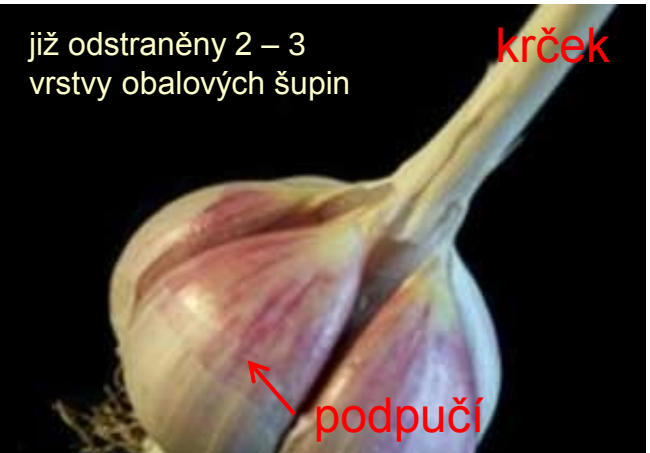
- Sulphur compounds: basic element of essential oils: Alliin (cysteine derivate), diallyl sulphide, diallyl trisulphide
- Garlicin and allistatin: natural antibiotics
- Amino acids, enzymes, trace elements

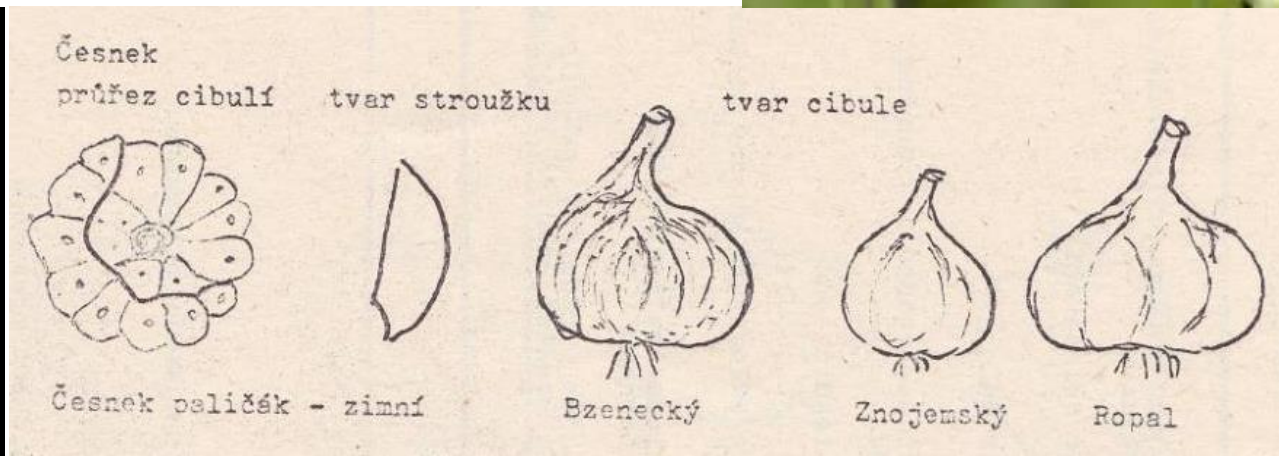
Botanical characteristics

- Czech Republic: only vegetative propagation from cloves and aerial bulblets; garlic does no produce seeds (except for certain kinds of ornamental garlic)
- 8-15 flat slot-shaped leaves
- Fascicled roots (more bulky roots than onion)
- Bulb is divided into cloves
- Flower stem: 0.8-1m (hard-neck garlic only), grows from corm, umbel (sterile flowers) at the top
- Three types of garlic:

Hard-neck garlic (winter purple garlic)

- Purple garlic which forms flower stem and inflorescence; aerial bulblets, fleshy vegetative formations, grow at the base of flower stem
- Hard, firm neck: bottom part of the flower stem
- After the neck is plucked out, bulb separates into individual cloves
- Average yield: 6 t/ha
- Worst storability: below average, should be sold immediately (rotting)
- Used for garlic spreads
- Planting: Autumn (November)





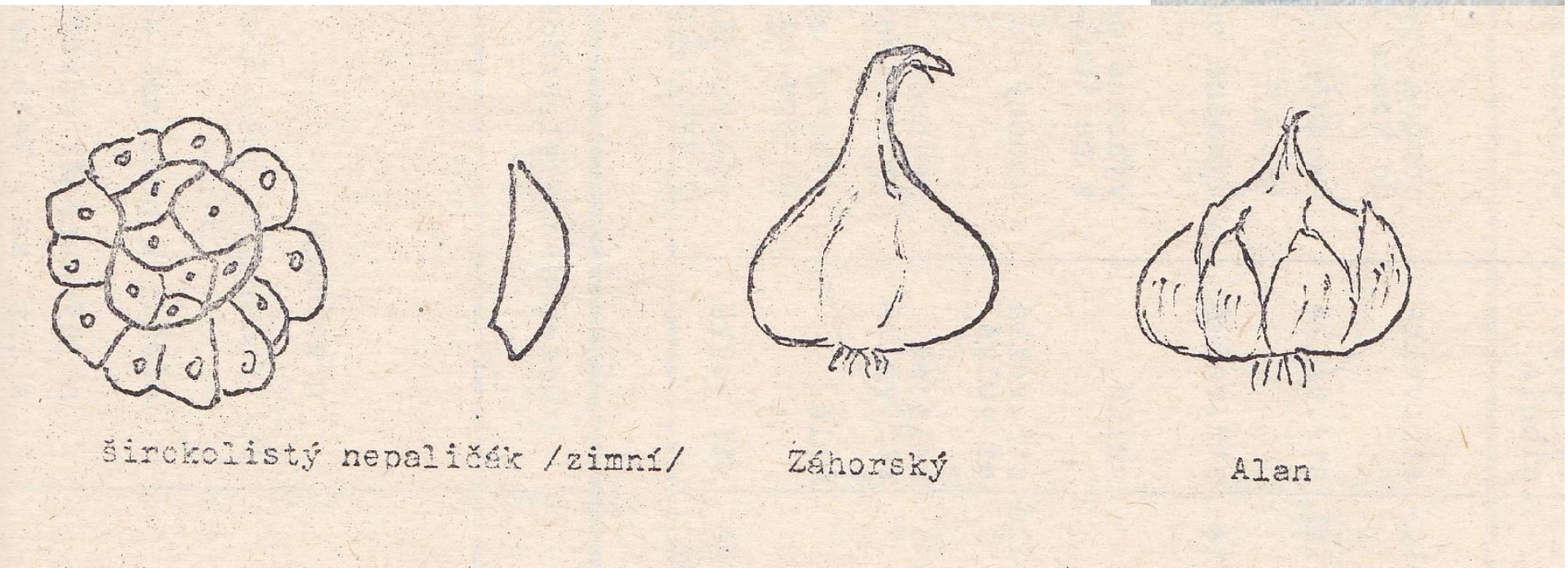
Aerial bulblets

- Fleshy formation of garlic for vegetative propagation (similar to peas)
- Bulblets do not have to be removed as they may be used for propagation, which lasts 3 years though:

1. Aerial bulblet is formed at the end of flower stem the first year
2. Second year: Uniform undivided bulb (2-3cm), leave in the soil
3. Third year: large bulb divided into cloves, 5 and more cm

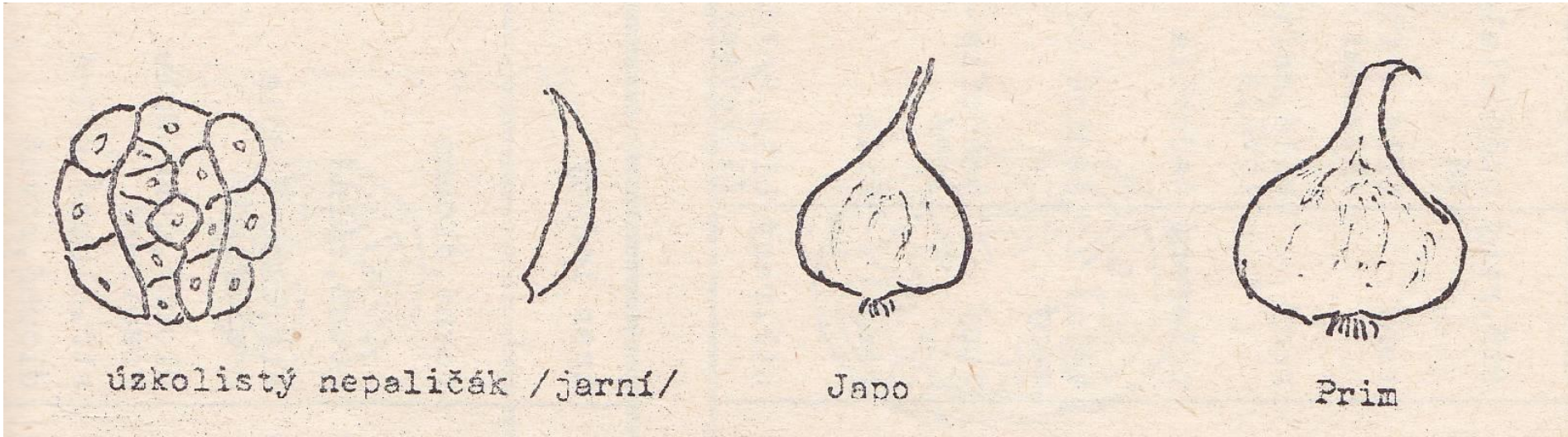
Wide-leaf soft-neck garlic varieties (white winter garlic)

- Up to 3cm wide leaves
- Soft flexible neck, no flower stem
- Above-average yield: the best yield (more than 10-12 t; planting: 1 t/ha)
- Average storability (till March)
- Planted in autumn (November)



Narrow-leaf soft-neck garlic (white spring garlic)

- Thin, narrow leaves (1 cm), small and narrow sickle-shaped cloves
- Below-average yield (the worst yield: 4 t; planted: 1.3 t/ha)
- Excellent storability (the best of all garlics): till the end of May at least
- Planted in spring



Cropping practices

- Humous, loamy, light sandy soils; pH 6.5-7.2

  Not recommended: heavy soils with high level of underground water
- Locations: sunny, warm, protected against strong wind
- Best planting stock comes from heavier sugarbeet growing soils; replanting is not recommended; planting stock should come from cold regions
- Medium feeder, light feeder in humous soils
- Spacing: 30-40 x 10 cm

- Disinfection of planting stock
  - No stem and bulb eelworm in the CR for 10 years, no need to disinfect (Spain is infested with eelworm!).
  - 5% Sulka, a disinfectant against eelworm and fungi: let act for 12 hours, dry to its original weight, or plant immediately
  - Today's disinfection practices: 20 min only Fundazol: fungicide (does not work against eelworm)

- Planting
  - Sowing machine (not good, cloves are not positioned properly)
  - Manual

- Planting depth:
  - In autumn: 5-8 cm (prevents freezing out)
  - In spring: 3-5 cm

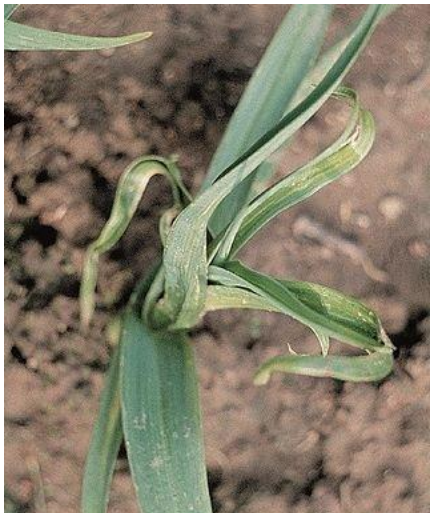
- Planting stock: 1.0-1.4 t/ha
- Even out soil around the plants after planting
- Irrigate during dry seasons (April, May, early June)

Planting

Winter	Spring
Hard-neck garlic, wide-leaf	Narrow-leaf soft-neck garlic
early November	March
Prevention against early sprouting, no infestation by garlic fly in spring	Early spring planting Harvest in Sep.
Disinfection with fungicides	Not infested with garlic fly
Planting depth: 5-8cm, in autumn	Planting depth: 3-5cm, in spring
Early spring planting Harvest in Aug.	

Garlic fly *Suillia lurida*

- Fly, lays eggs on tops of sprouting garlic, 1 egg per plant (odour marking)
- If temperatures rise above 10°C for a period of 4-5 days, the flies fly buzzing at ankle height (may start already in January)
- Larvae eat through the plant, vegetation top turns yellow, starts curling and dies. Flies may infest up to 60% of plant stands.
- Protection: late planting, garlic sprouts in late March and avoids the infestation
- Or the plants may be covered with non-woven fabric (expensive solution)



Harvest (leaf tops start to dry)

- Soft-neck garlic: leaves turn yellow and plants start to lay flat
- Hard-neck garlic: leaf tops start to dry and flower stem straightens out

- Lifting: subsoiler machines
- Small growing areas: manual harvest, bulbs cannot be damaged (no harsh removal of soil)
- Drying process: in the field or in ventilated premises (preferred method)
- Cleaning, removal of damaged and soiled coats, removal of roots
- Storage: containers, 0°C, 75% air humidity

- Yield:
  - 4 t/ha (narrow-leaf, soft-neck garlic)
  - 6 t/ha (hard-neck garlic)
  - 12 t/ha (wide-leaf, soft-neck garlic)

- Third weekend in September in Buchlovice: Garlic Auction; garlic sets (150 CZK/kg) as well as garlic for direct consumption

- Czech garlic has twice as many nutrients as Chinese garlic

Downy mildew *Perenospora destructor*

- Oval, yellow spots on affected leaves which get bugger, turn light brown and produce grey coating in wet weather

First symptoms: leaf tops turn yellow

Coating of fungi sporulation

▲ Detail pod lupou – povlak sporulace houby

- Late on, leaves break at the affected areas and dry quickly
- Infested plant stands look as if they were struck with hail-storm
- Tissues are colonized by other fungi
  - darkening of affected areas
- Wet and rainy weather favours this disease

Grey leaf coating

Dead leaves often turn darker colour later

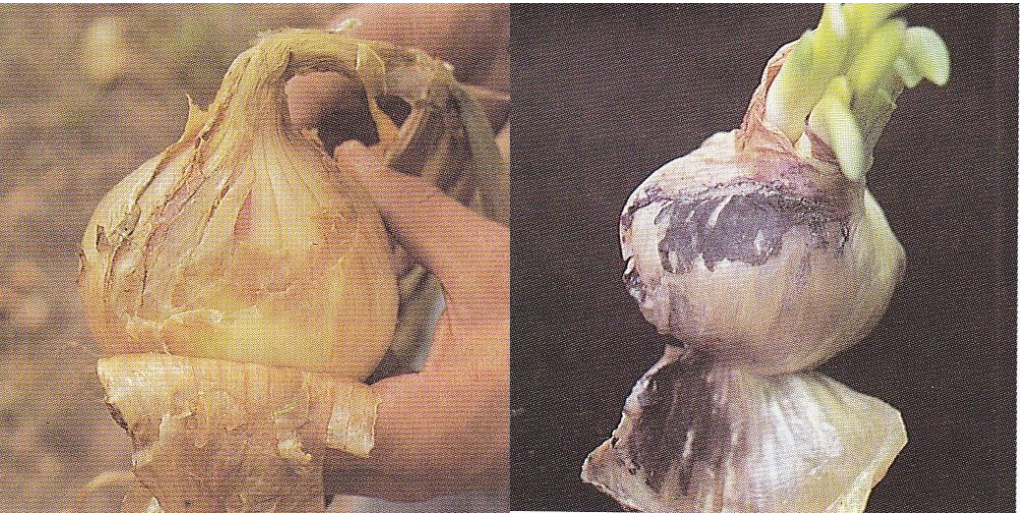
- In several days, downy mildew destroys the whole tops, and bulbs are infested with other diseases.
- Preventive spraying of healthy plant stands

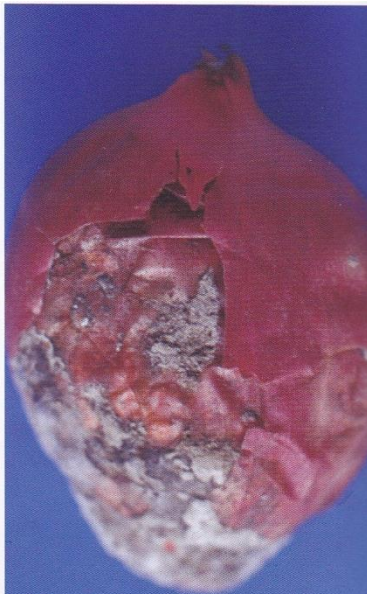
  at the end of May, early June

  Curzate 0.3% Kuprikol 0.7% Mikal 0.6%
- Repeat after 14-21 days
- Infested onions cannot be stored

Neck rot *Botrytis allii*

- Brown spots around onion neck, inside of the onion looks as if the onion was “cooked”, fluid flows from the inside infecting other stored onions
- Affects onions with open necks (bolting onions)
- Czech people often steal onions left on the field to dry and farmers therefore prefer to dry onion on grids, which is an inferior method compared to direct sun drying





- Prevention:
  - Crop rotation at affected soil for min. 3 years
  - Chemical agents against neck rot
  - Weed elimination
  - Good timing of harvest (bottom 1/3 of a leaf is green, 2/3 of the tops are lying flat) and quick drying (disease outbreaks when leaves are drying after they lied down)
- Direct chemical prevention is not practiced

Purple blotch *Alternaria porri*

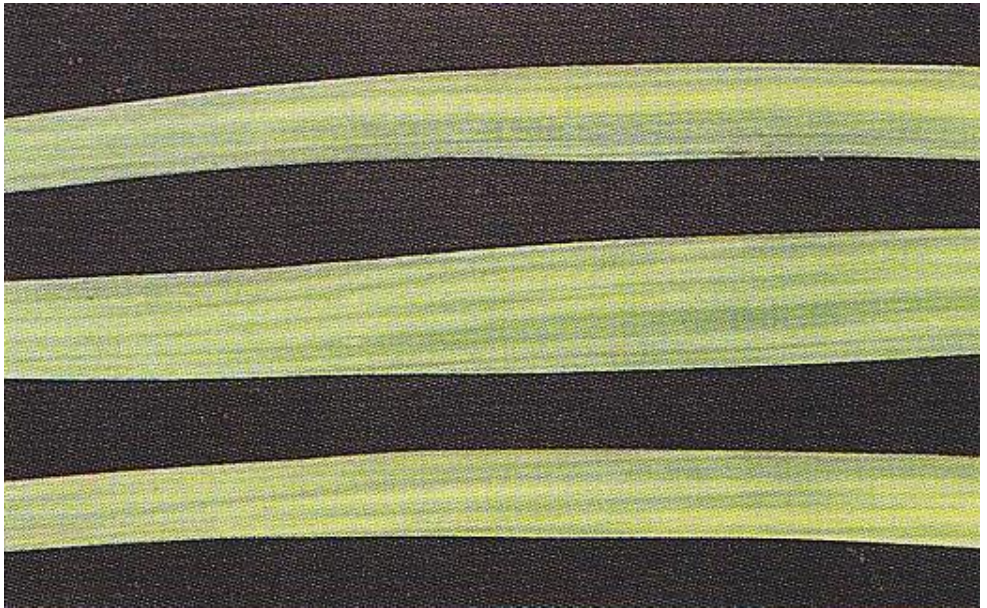
- Affects leek and chives mostly
- Oval, grey to brown spots on upper half of leaves which turn purple in the middle with violet edges
- Strongly affected leaves curl up and die
- Disinfection of seeds
- Removal of postharvest residues
- Thin plant stands
- No excessive nitrogen fertilization

Onion rust *Puccinia allii*

- Narrow, orange rusty spots on leek leaves, up to 5mm long
- Strongly affected plants: growth depression, leaves paling
- August and September

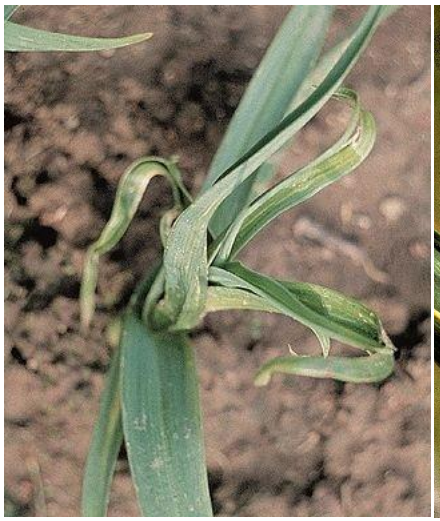
Onion yellow dwarf virus

- Onion, leek, chives
- Light green and yellow stripes on leaves
- Wilted leaves without vigour
- Prevention: pesticides against greenflies (transferring agents)



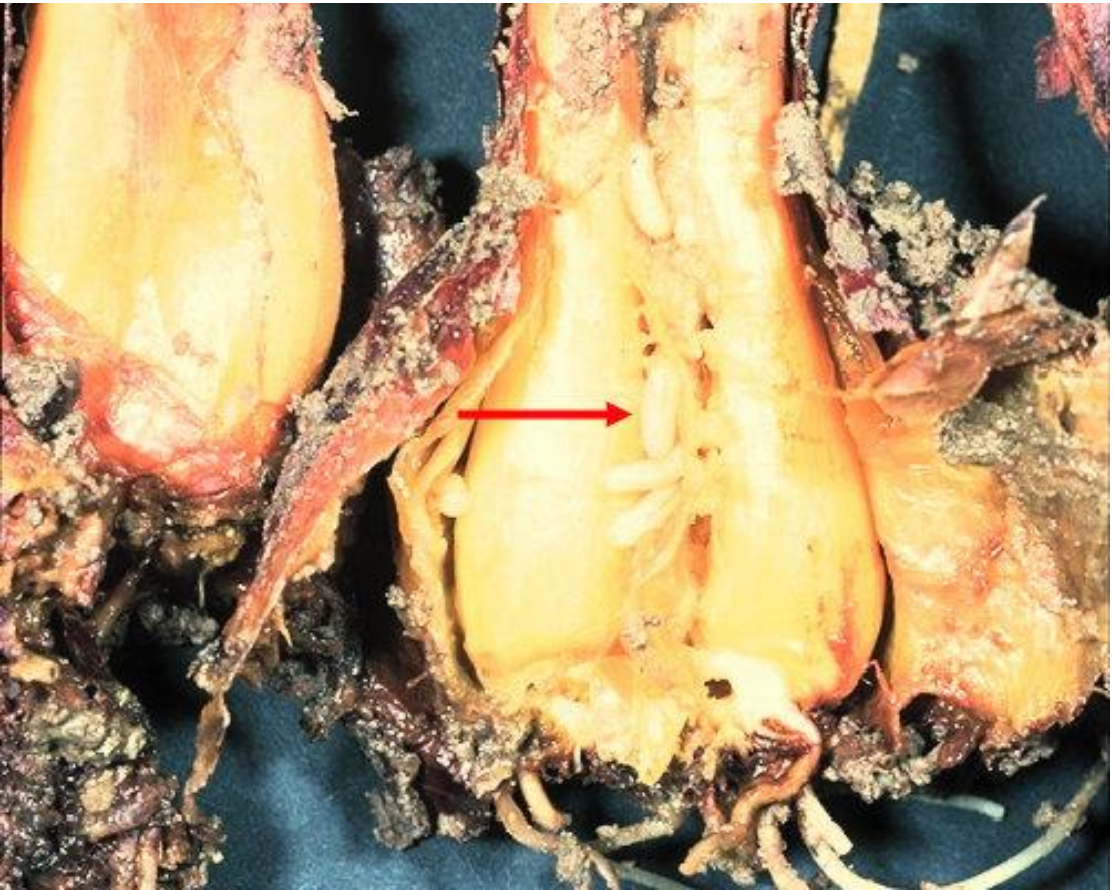
Garlic fly *Suillia lurida*

- Fly, lays eggs on tops of sprouting garlic, 1 egg per plant (odour marking)
- If temperatures rise above 10°C for a period of 4-5 days, the flies fly buzzing at ankle height (may start already in January)
- Larvae eat through the plant, vegetation top turns yellow, starts curling and dies. Flies may infest up to 60% of plant stands.
- Protection: late planting, garlic sprouts in late March and avoids the infestation
- Or the plants may be covered with non-woven fabric (expensive solution)

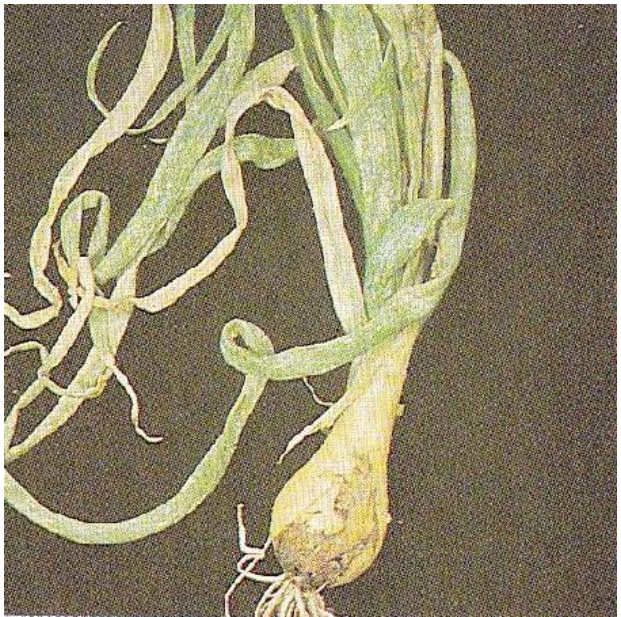


Onion fly *Delia antiqua*

- Infested onions start wilting from late May
- Older plants: leaves curl up
- 8mm long, yellow-white larvae are feeding on infested onions



- 2-3 generation within a year
- Eggs are laid on plant basis
- Dry weather destroys eggs significantly
- Protection: non-woven fabrics (nets with 2mm holes)



Leaf miner *Liriomyza cepae*

- 2-3mm long fly make punctures in young onion stems
- Light-yellow larvae: distinctive lines of white dots on the foliage
- Spring generation damages winter onion, winter garlic and winter leek
- Autumn generation of leaf miners damage autumn and winter leek

- Protection: unwoven fabrics
- Insecticide: if more than 10% of stems are infested