Harvesting

- From the end of October to December; during mild winters with temperatures not falling below –12oC, sprouts overwinter (harvesting through the winter until the spring)
- Sprouts are stripped from the stalk by a rotary device directly in the field – they do not last and wilt in shops
- Sprouts used to be harvested with machetes including the stalk and did not fade

The minimum diameter of sprouts required is 10-15 mm

Yields

- 10-15 t of stripped marketable sprouts per hectare
- Price: 1 kg = 30 CZK

Storage

- –2°C
- 7 weeks – stripped sprouts
- 90-95% humidity

CAULIFLOWER (Brassica oleracea L. var. botrytis L.)

- Place of origin: The Mediterranean, Asia Minor
- One of the oldest cultivated plants
- Spread to Europe from Crete and Cyprus, having been cultivated in Central Europe since the 18th century
- Cauliflower is among the most widespread and most demanding vegetables

- A wide range of uses:
  - ➢ Storing for a short period of time
  - ➢ Processing at freezing plants and canning factories

- The edible portion is
  - A pulpy, fasciated (altered, reduced) inflorescence – white, yellow, purple
  - ➢ Cauliflower forms semiglobose, firm curds consisting of short, branched, pulpy shoots ending with curled buds, the curds being covered with large leaves
  - Good covering with leaves is of advantage – the curd is shielded from the sun and there is no need to crack and bend leaves over
  - The larger the leaf rosette, the larger and higher-quality the edible portion

- The root system is weaker than that of cabbage or kale

- Seed germinative capacity of 4-5 years, TKW of 2.7-3.5 g

- Consumption in the Czech Republic:
  - 2.6 kg per capita per year, 80% of which is eaten fresh
  - Consumption of cauliflower is decreasing in favour of broccoli

- A yield of 30-35 t/ha

- An amount of manual labour of 600 h/ha (harvest)

Production Areas in the Czech Republic

Early cauliflower under 200 m above sea level

- The towns of Mělník, Litoměřice, Nymburk, Brno, Olomouc, Přerov, Hodonín, and Znojmo

Late cauliflower under 500 m above sea level

- Regions where early cauliflower is grown
  + The towns of Písek, Plzeň, Náchod, Liberec, Opava, and České Budějovice

- Cauliflower of the highest quality from autumn harvests comes from higher locations in 400-500 m above sea level
  (The Žamberk region – the foothills of the Jeseníky mountain range)

Nutritional Value of Cauliflower

Dry matter 8.4%
Dietary fibre 1.8%
Proteins 2.4%
Lipids 0.3%
Saccharides 4.4%

Ca	530	Zn	2.2	B1	1.17
Fe	7.2	S	336	B2	0.89
Na	200	I	0.009	C	390
Mg	150			E	1.2
P	540				
K	2,500	(mg/kg of fresh matter)			

Soil and Fertilisation

- Fertile, humus-rich, loam soils with good moisture-holding capacity
  - Early cultivars – lighter, heat-retaining, sandy loam soils
  - Summer and autumn cultivars – heavier, beet-growing soils
- **A humus content of over 3%,** a pH of 6.8-7.5
  (Greater utilisation of rain and irrigation water and mineral fertilisers)
- Preceding crops: leguminous plants, leguminous fodder plants, annual fodder plants
- As a heavy feeder – 40 t of stable manure, the commercial compost Bioganic or a double amount of green manure
- Also as a medium feeder – early cauliflower on humus-rich soils
- P and K fertilisers:
- Together with manuring on heavier soils
- Only at the seed-bed preparation on lighter soils

- Cauliflower requires high humidity and a sufficient amount of water in the soil
- Delayed formation of curds – shading
- Leaves growing in curds – high temperatures above 20oC after the curd has formed
- Riceyness – high temperatures before the curd formation and cold weather during the curd formation
- Biological stress – an insufficient supply of nutrients and water and inadequate temperatures

Individual florets are irregularly ragged

("like grains of rice").

- Molybdenum deficiency – whiptail
  - Spray the seedlings with 0.1% sodium molybdate before planting

- Boron deficiency – browning of curds (brown or rust-coloured patches that break down at a later stage, curds have a bitter taste)
  - Prevention – pre-sowing fertilisation with 25 kg of Borax per ha or spraying of seedlings

- Need to crack leaves – early cauliflowers – poor foliage

Cultivation Techniques

1. Planting stock pre-cultivation

Early cultivars

- Sowing from the end of January to the middle of February
- Planting from the end of March to 10 April
- A spacing of 0.5 x 0.4

Late cultivars

- Sowing in mid-April • Planting in the second half of June
- A spacing of 0.6x 0.6

Mini-plugs

- A temperature of at least 16oC (otherwise the cauliflower vernalises)
- 3-4 true leaves at the time of planting
- Need to harden off seedlings before planting (ventilation for a week)
- Foreign cultivars – expensive seed

2. Direct sowing with summer and autumn late cauliflowers

- High requirements on seed-bed preparation

– Firm subsoil, topsoil loose up to 3 cm

- The second half of April – precision seed 0.7 kg per hectare
- Roll the soil mildly after sowing
- Protect against flea beetles and Meligethes (with rape – non-woven fabric)
- Better adaptation to extreme conditions (lack of water)
- Highest demand for moisture at the stage of formation of flower heads

Harvesting

- By thinning, harvesting platforms, 3-4 times

Cauliflower is distributed

- With wrapper leaves
- Sot that they cover the curd entirely, the stalk is cut off just below the wrapper leaves
- When sold in shops, leaves can be cut short, but not removed (Lacking foliage causes blackening and bruising of curds; leaves are needed to separate curds)

The yield from 1 ha is 30,000-35,000 curds; cauliflower is sold per pieces.

A minimum diameter of the head is 110 mm but it is a matter of agreement nowadays.

Refrigeration and Storage

- A temperature of 0-2°C
- Until December (cauliflower is not locally stored nowadays, it is imported from abroad)

Outlooks

- An increased proportion of cauliflower processed at freezing plants at the expense of pickled cauliflower
- An increased percentage of cauliflower stored on a short-term basis for November and December
- Import only for January–April

BROCCOLI (Brassica oleracea L. convar. botrytis var. italica)

- Originated in the Mediterranean as early as at the time of Ancient Rome
- Within Europe, broccoli occurred in Italy in the 17th century and spread further after World War II
- In the Czech Republic, broccoli has only been mass-produced since 1994
- From the point of view of nutritional value, broccoli is one of the most valuable vegetables

- Similar to cauliflower – a more robust root system
- The edible portion – a head = undeveloped flower buds of a green to purple colour and a diameter of 100 to 200 mm
- Heads are harvested including the stalk which is also eaten
- In the case of delayed harvest, broccoli develops small, yellow flowers – an acrid flavour, inedible

1. Sprouting broccoli
(Brassica oleracea L. convar. botrytis var. italica)

- Less compact heads than those of cauliflower
- More or less remontant forms (a cultivar characteristic)
- Central (top) head of 10-15 cm •
  After this head is harvested, 4 to 10 side heads 3-5 cm in size form within 2-5 weeks
  (in the leaf axils of the new side axis)
- Big growers only harvest the top heads

2. Heading broccoli
(Brassica oleracea L. convar. botrytis var. botrytis)

- Grown mainly in seaside regions – humid areas (the Mediterranean, England, and France)
- Tall, thick stalks, longish leaves, only top heads of a white, yellow, or purple colour
- The broccoli is planted in the summer, overwinters at the stage of a leaf rosette, and forms heavy and firm flower heads in the spring
- The broccoli cannot be grown in the Czech Republic (high temperatures and dry weather)

Nutritional Value of Broccoli

One of the most valuable vegetables – vitamins and minerals

Dry matter	8.6-10.8%
Dietary fibre	0.9-1.3%
Proteins	2.2-3.3%
Saccharides	3.5-4.2%
Ash	0.9-1.1% (Mainly Ca, K, P, S)

A higher content of vitamin C in autumn harvests

The absorption of Ca is up to 50%, in the case of synthetic Ca, it is only 20%

An anti-sclerosis effect

Broccoli positively affects duodenal and stomach ulcers

Treatment for irradiation sicknesses

The glucosinolate sulforaphane – hinders cancer cell growth

Vitamin and Mineral Content in Broccoli and Cauliflower (mg.1,000g-1 of Fresh Matter)

Vitamin	Broccoli	Cauliflower
C	800-1,800	400-600
E	8-20	0
A	1	0
B1	0.8	1.1
B2	2.3	1.7
Ca	1,100	250
P	780	540
Fe	11	10
Na	150	130
K	3,800	3,000
Mg	240	240
S	1,350	1,200
Frost resistance	–8oC	–2oC
Head weight	300-1,000 g	400-2,000 g

Vitamin E and C Content in Broccoli Depending on the Harvesting Time

Cultivar	Vitamin E		Vitamin C	
	Harvesting			
	August	November	July	November
Buccaneer		11	17	1,023	2,036
Colonel	7	8	945	1,152	
Emperor	9	9	895	1,073	
Fiesta	7	9	937	1,062	
Geba	10	12.5	632	944	
Kermit	7	12	979	1,307	
Viking	9	10.5	1,370	2,010	
Skiff	9	9	940	1,054	
Shadow	12.5	15	1,539	1,852	
Switch	7	9.5	1,032	975	
Corvet	6	9.0	871	958	

Optimum conditions for broccoli – Autumn:

– Falling temperature

– Rising humidity

Broccoli Cultivation Techniques

Crop	Early	Summer	Autumn
Sowing	20 January–10 February	1 March–25 May	1 June–10 June
Planting	15 March–31 March	15 April–30 June	15 July–31 July
Harvesting	15 May–1 June	15 June–1 September	20 September–30 November
Spacing	45 x 45	60 x 35	60 x 35	60 x 40
Number of plants	48,000-50,000	48,000	42,000
Yield (t.ha-1)	8-10	10-20	20-30

There is no bolting in the autumn.

TKW of 2.5-3.5 g

The head tolerates a frost of -8°C without being damaged

Cultivation Techniques

Early crop

– Planting of mini-plugs
– Irrigate thoroughly
– The crop must not dry out excessively! (stress)

Summer and autumn crops

– It is more profitable to pre-cultivate planting stock (high seed prices)
– direct precision drilling of 0.5 kg/ha

Quality Standards

- The minimum diameter of inflorescence is 80 mm, the length of the edible portion including the stalk is 200 mm
- Packed and compact heads

Storage

- 0-1oC 5-6 weeks
- 5oC 5-10 days

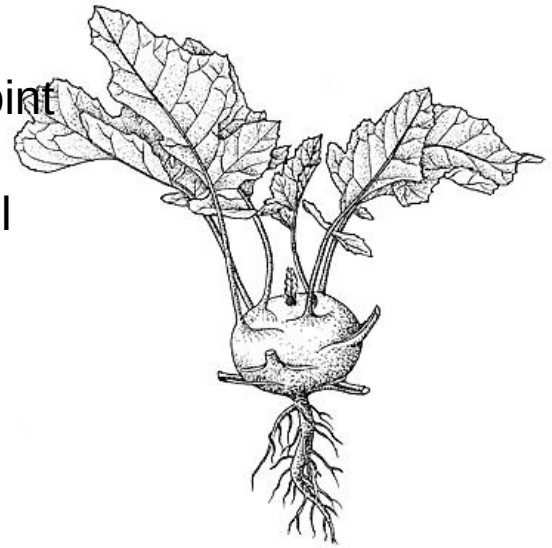
All broccoli residues can be fed to domestic animals (rabbits) = a non-waste crop.

Deer graze broccoli preferentially.

KOHLRABI

Brassica oleracea L. convar. acephala var. gongylodes (L.) Markgr.

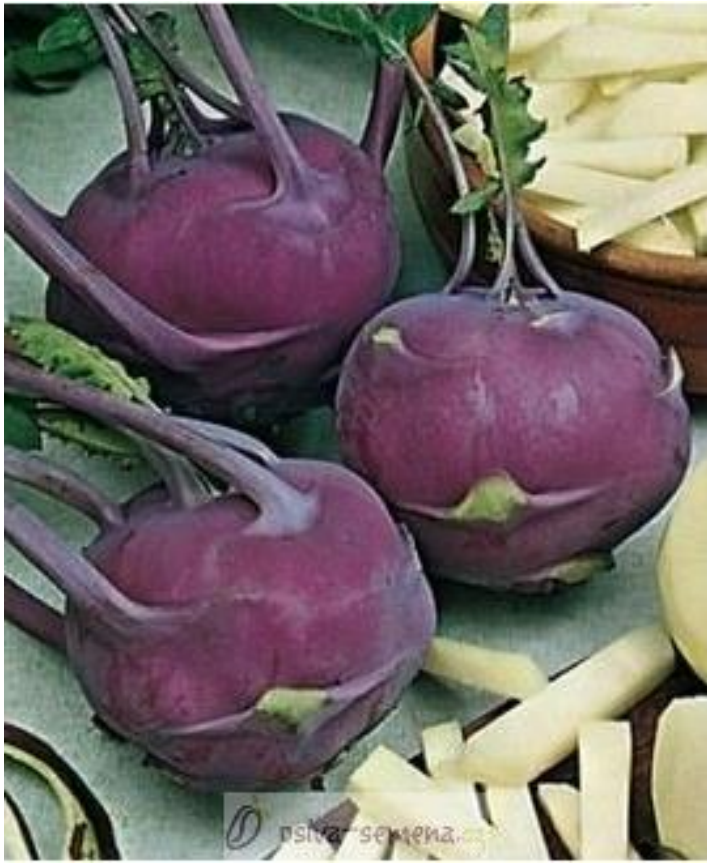
- Kohlrabi comes from the Mediterranean and was already known in Ancient Rome
- Most frequently grown in Western and Central Europe
- A short growing period, a wide range of culinary uses
- From the original wild Brassica oleracea
- Axial tuber – forms by a reduction in the stem length and considerable secondary thickening at the growing point (Incorrectly called a bulb)
- The weakest root system of all cole crops – short and fibrous



- Cultivars are distinguished by colour, shape, and tuber size

- White (var. alboviridis)
- Purple (var. purpurescens)

Thinner skin – more susceptible to splitting of tubers
Thicker skin – more juicy, tastier



Nutritional Value of Kohlrabi

Dry matter	8.7%	Dietary fibre	2.2%
Proteins	2.1%		
Lipids	0.2%	Saccharides	5.8%

Ca	630	Zn	1.7	B6	1.2
Fe	42 (!)	S	400	C	450
Na	520	I			
Mg	240				
P	513	1.3			
K	2,300	(mg/kg of fresh matter)			

Cultivation Techniques

- Loam and loam sandy soils with a sufficient content of humus and a sufficient nutrient reserve, a pH of 6.0-7.3
- Unsuitable – clay, impermeable soil
- As a heavy feeder 35 t of manure, compost
- Essential is additional irrigation during the whole growing period
(At least once a week, preferably twice a week, not more than 15 mm)
- At the time of seedling pre-cultivation, kohlrabi needs a temperature above 14°C
(Otherwise it vernalises and bolts)

EARLY CULTIVARS

1. Planting stock pre-cultivation (60-65 days)

- Sowing between the end of January and the beginning of February
- Planting – during the last ten days of March, at the beginning of April
- A spacing of 25 x 25, 25 x 30, 30 x 30
- 120,000 pcs/ha (200 g each)

2. Direct sowing in the field (early cultivars)

- Between the end of March and the beginning of April
- Harvesting:
- By thinning at 2-day intervals, a yield of 20-30 t/ha
- Harvest duration of 2-3 weeks, the kohlrabi is not storable

LATE CULTIVARS

- Planting stock pre-cultivation or direct precision drilling
- Sowing between mid-April and the beginning of July
(Depending on the earliness of the cultivar)
- Planting from the end of May to the end of July
- A spacing of 30 x 40, 40 x 40 cm
- Harvesting – between July and October on a one-off basis, without leaves
- A weight of 400-500 g (Gigant 2,000 g)
- A yield of 45-50 t/ha, convenient to store until March
- A growing period of 130 days from planting

	EARLY CROP	SUMMER CROP	LATE CROP
Sowing	Beginning of February	March–April	May/June, end of May–
Planting	End of March May–	April–May	middle of July
Harvesting	June	June–August	August– October
Spacing	25 x 25	30 x 30	40 x 40
		Not grown, no demand or sale	

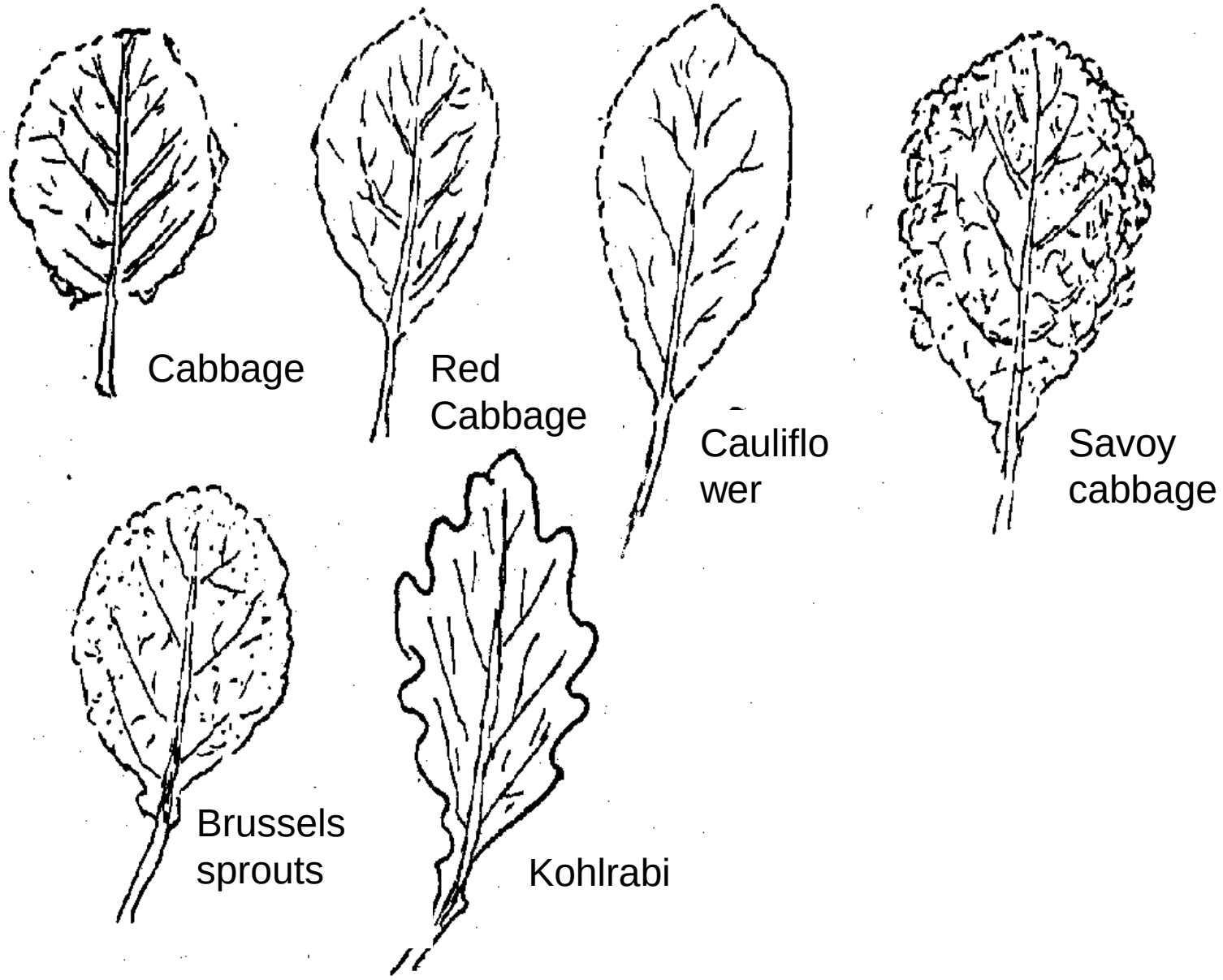
EARLY CROP
FOR LATE HARVESTING
Sowing Mid-July
Growing period from planting in days
Planting Mid-August
Early white 75-90
Harvesting September–October Early purple 80-96
Medium early 110-120
Spacing 30 x 30 Late 130-150
Need to cultivate early cultivars that have small tubers,
which is not profitable

Quality

- Tubers that are not cracked, have not bolted, do not have woody pulp, whose stalk is smoothly cut off, and that have a diameter of:
- At least 50 mm with white kohlrabi with early kohlrabi leaves
- At least 55 mm with purple kohlrabi with early kohlrabi leaves
- At least 70 mm with kohlrabi without leaves (I.) late kohlrabi
- At least 60 mm with kohlrabi without leaves (II.) late kohlrabi

Nowadays, it is a matter of agreement between the grower and the customer.

Differentiation of Seedlings of Cole Crops by the First True Leaf



Physiological Disorders
Cauliflower, Broccoli, Kohlrabi, Cabbage
Whiptail
SYMPTOMS

- Hearts do not form, blades of young leaves are heavily distorted

CAUSES

- A lack of MOLYBDENUM in the soil, acidic soils (blocking Mo)
- (Presence of the kohlrabi midge)
- Spray seedlings with 0.1% ammonium molybdate or sodium molybdate, do some liming – adjustment of pH

Physiological Disorders

Cauliflower, Broccoli, Kohlrabi, Cabbage

Browning of the curd, hollow stem

- Browning of the curd

Hollow stem in broccoli

- A lack of BORON in the soil
- Spray with fertilisers containing B
- Spray seedlings with 0.2% boric acid

Physiological Disorders
Cabbage
Splitting of heads
• Cause
– Physiological overmaturing (delayed harvesting of early cultivars)
– Irregular water uptake – a sudden uptake after a dry season

Physiological Disorders

Kohlrabi

Splitting of tubers

- Uneven growth due to unequal soil moisture, irregular irrigation
  - Fluctuations in irrigation, a long-lasting dry season
  - It starts raining, there is no regular irrigation twice to three times a week
- Infestation by the weevil

Physiological Disorders

Kohlrabi Lignification

- Inner tissues drying out
- Fluctuations in irrigation, a long-lasting dry season •The plant is trying to propagate and draws moisture from storage tissues in order to develop an inflorescence
- Some cultivars are obviously susceptible (Kozmanova modrá - "The Kozman Purple")
- Prevention – water regularly

Physiological Disorders
Cauliflower, Broccoli
Buttoning

- Small heads form

– The plant is stressed by dry conditions – in fear of dying, it starts heading – the initial effort of the plant to propagate

- It happens that seedlings dry out or irrigation is neglected
- Young plants are better adapted to stress
- Younger seedlings (3-4 leaves) are hardier than older seedlings (5-6 leaves)
- Encouraged by dry, too warm weather

Physiological Disorders
Cauliflower, Broccoli, Kohlrabi
Bolting

- A quality edible portion does not develop
- Plants run to flower
- Seedling pre-cultivation at low temperatures below 10oC
- Specific condition in kohlrabi – if the temperature drops below 10oC for 3-4 hours, there are no consequences, but if this happens for 2-3 days, vernalisation occurs, it comes to bolting in all seedlings, which is only to see in the field □□Do not plant at all!
- Dry, warm weather at the time of formation of the edible portion

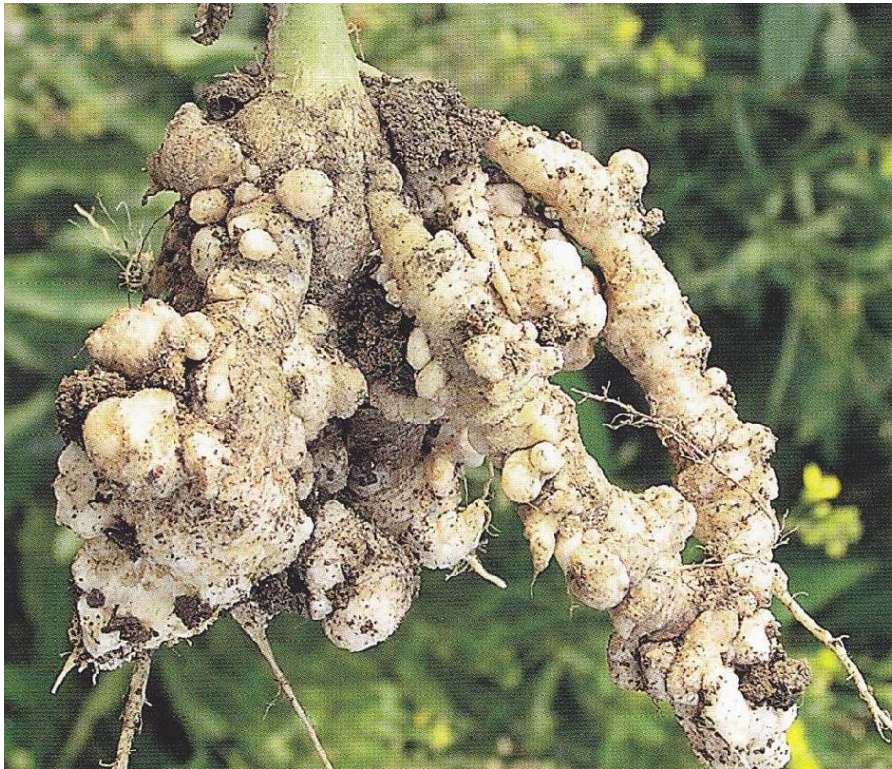
Club root

Plasmodiophora brassicae

- Lumpy swellings on the roots, when cut open, the little "tumours" are filled with tissues; permanent spores contaminate the soil to a depth of 25 cm for more than 10 years
- Poor growth, wilting, lower yields; club root centres around focuses, on all brassicas including weeds
- Club root reduces the yield by 50% on cole crops

- There is no drop in yields in the case of oilseed rape!

Rape is a vector



- Plant healthy seedlings, use healthy substrate
- Transmitted mainly via seedlings – contaminated substrate
- Alkaline soil reaction is of help
- Raise the soil pH to 7
- Discontinue growing host plants for 6-8 years
- Eradicate brassica weeds
- Apply 0.1 kg of lime nitrogen per m2 before planting

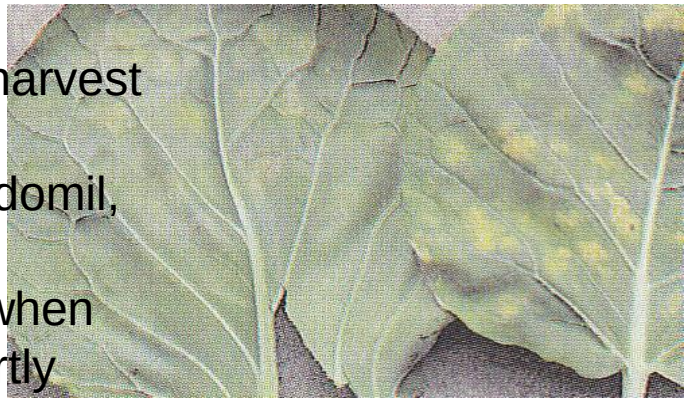
All Cole Crops, Beijing cabbage, Chinese cabbage

Blackleg Phoma lingam

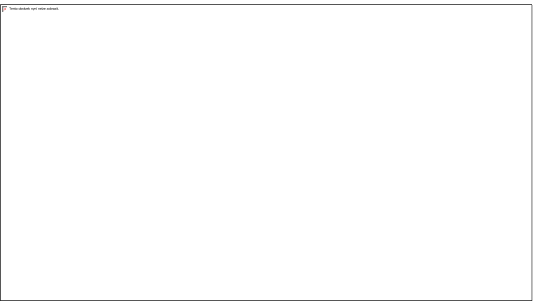
- On the stem, leaves, root neck, and roots of young plants, there emerge grey-brown spots, leaves become yellow and prematurely die back; slimy rot occurs at storage; blackleg occurs in maturing plants
- Prevention: dress seeds, dispose of post-storage residues
- Spray – Ridomil, Pomarsol forte
- Blackleg is not frequent and symptoms appear when vegetables are placed in a storehouse

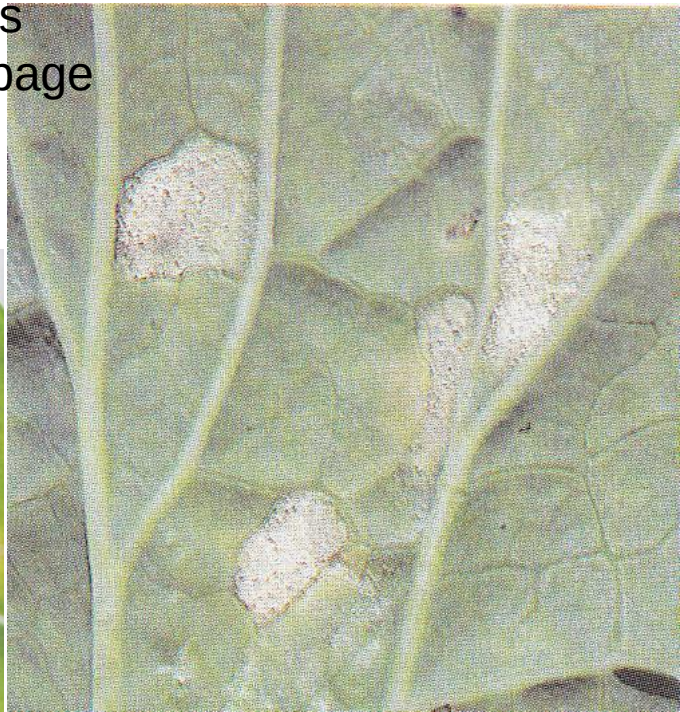
All Cole Crops, Peking cabbage, Chinese cabbage
Downy mildew (in brassicas) Hyaloperenospora parasitica

- Yellow spots on the upper surface of leaves, a grey-white growth on the lower surface of leaves, dark spots on older leaves
- The fungus survives in the seed and in post-harvest plant residues or winter brassicas
- Dress seeds, dispose of residues, spray – Ridomil, Pomarsol forte
- The disease does not occur frequently, only when there is a longer rainy season; to prevent it, spray shortly before formation of heads
- The disease spreads on post-harvest residues
- The disease affects Peking and Chinese cabbage



Lower surface
Upper surface





Cabbage, Kale, Cauliflower, Peking cabbage

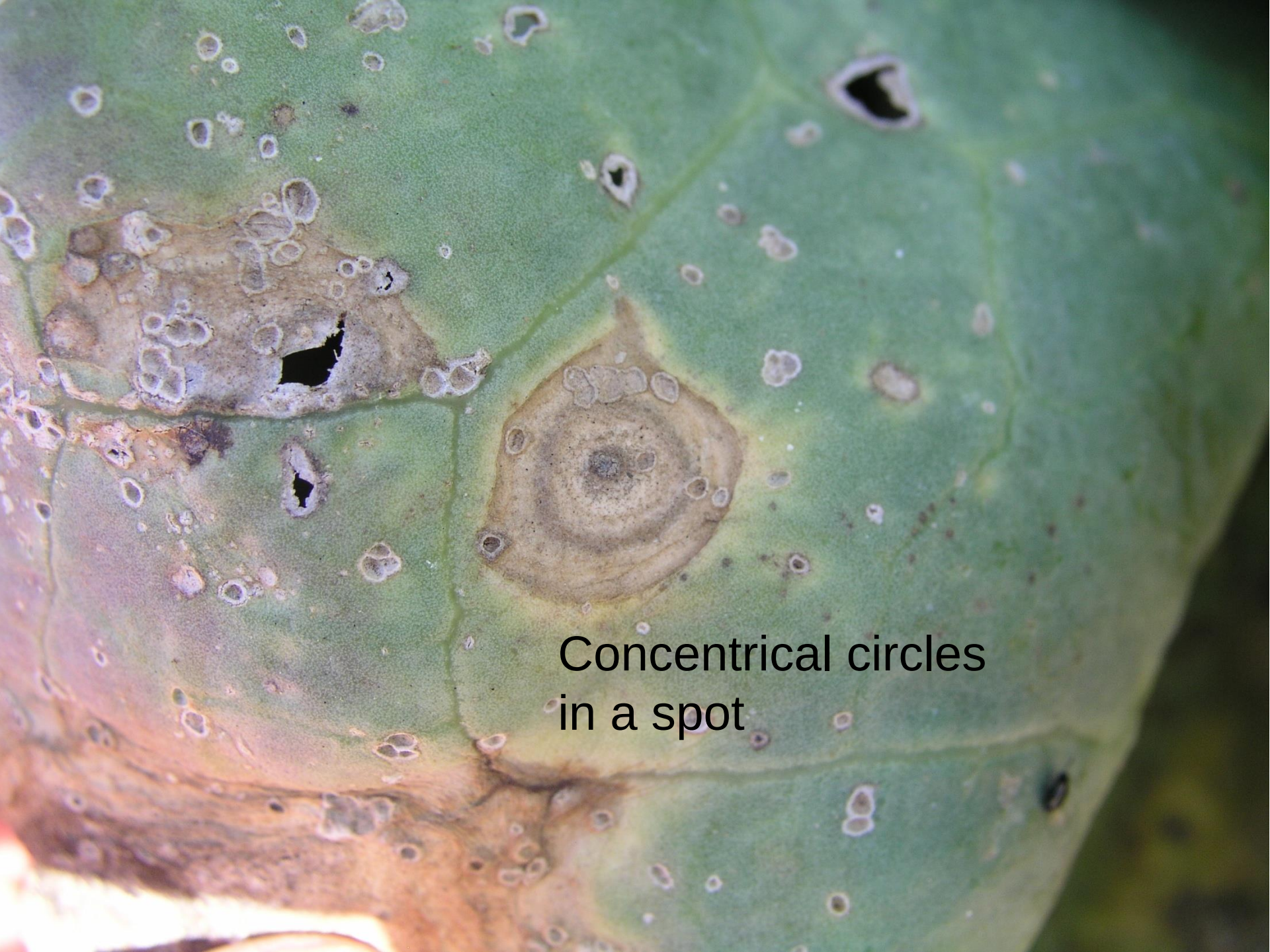
Alternaria leaf spot Alternaria brassicae

- Yellow spots with yellow edges on the upper side of leaves, tissues dry out and fall out; the disease mostly appears in weaker plants in wet weather
- At the edges of leaves first, whole leaves and heads dry out fast within 2-3 days
- The fungus is transmitted via seeds and soil
- Carried from infected stands by air

- Perform seed dressing, dispose of post-harvest residues
- Spray – Ridomil, Pomarsol forte
- A disease of wet autumn
- Mainly in Peking cabbage, one preventive spraying will do

– If the forecast says there will be a rainy September, spray during the first ten days of September

- It is not necessary to spray during a sunny autumn


Concentrical circles
in a spot

All Cole Crops, Especially Peking Cabbage
Bacterial soft rot Erwinia carotovora

- Watery, gradually rotting spots, a distinctive foul smell on damaged parts in storage, affected parts become mushy
- Perform seed dressing • Grow brassicas at minimum 5-year intervals
- Dispose of post-harvest residues (They cannot be composted)
- Low storage temperatures of 0-1°C slow down the course of the disease