



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**

CROP ROTATION

1. Use of microclimatic and soil **conditions**

- Meet the needs of the crop as to:
 - Temperature** (maize production area, beet production area, potato production area)
 - Moisture** (possible water resources for irrigation)
 - Soil quality** (loam, sand, gravel)
 - Slope of the land** (possible use of machinery)

2. Alternate demanding crops with less demanding ones within the crop rotation

(Manuring, labour demands, irrigation)

a) Manuring

– **It is feasible to fertilise only 1/4 to 1/3 of the beds with organic fertilisers**, it is not possible to select all vegetables as the heavy feeders (Cucumbers, peppers, tomatoes, celeriac, leeks, etc.)

b) Harvesting

- It is not feasible to plant 3 kinds of vegetables that are **harvested manually during the same period of time**
- Cucumbers twice a week, peppers and tomatoes once a week
- It is necessary to combine e.g. onions and cucumbers

c) Irrigation capacity

- Not only demanding crops can be planted – it is desirable to alternate plants

3. Production intensity

- While using production resources and labour, production intensity has to:
 - **Maintain or even increase the effective soil fertility**
 - Save natural resources and protect the environment

No use of fertilisers is not feasible (!)

- Application of no fertilisers may be done for one year, but then the soil gets depleted and the fertility decreases
- Organic fertilisers have to be purchased, too – they are expensive but they pay

TYPES OF CROP ROTATIONS

– **Field crop rotations** 9-11 beds

- Field crops: 1-2 beds of vegetables
- A matter of the past, there are no large units, there is a lack of expanses of land

– **Vegetable-fodder crop rotations** 6-7 beds

- Annual fodder plants for livestock feed
- Advantageous – organic matter is gained

– **Specialised vegetable crop rotations** 3-6 beds

- Besides vegetables, there are crop mixtures for green manure to be ploughed under

Restriction – there is no organic matter –
stable manure

- It can only be supplied for $\frac{1}{4}$ of the area

Such a size of a bed so that no need
arises to divide the bed

Several crops on a bed – uneven stand –
another preceding crop

DISCONTINUING THE CROP SEQUENCE

Peas, onions:	4-5 years
Carrots, parsley, cucumbers, tomatoes:	3-4 years
Beans:	2-3 years
Lettuce, spinach:	1-2 years

- **3 to 4-year intervals** – a generally valid principle
- Only vegetables with a very short growing period can be planted for 2 successive years
- Carrots planted for 5 successive years – only 20% yield (!)

Perennial vegetables are not incorporated in crop rotations
(Asparagus, rhubarb)



Production Areas

Corn growing area

- It is possible to grow all vegetables
 - Primarily: **early cole crops** (early spring),
lettuce,
fruit bearing vegetables (peppers, aubergines)
 - **melons** (up to 100 m above sea level)

Beet growing area

- Good water-holding soils
- Moisture can be absorbed from a greater depth
- No need of very frequent irrigation
- **Root vegetables** (characteristic of beet production areas)
- **Late cole crops**
- It is more desirable to grow broccoli in beet production areas as it flowers too fast in maize production areas
- **Fruit bearing vegetables – tomatoes, peppers** (early cultivars only)

Potato production area

- Medium-late cole crops

 - A shorter growing period than that of late cole crops (1 month earlier, equal yield)

 - At low temperatures, medium-late cole crops do not form a solid head (cabbage)

- Carrots, parsnips (do not suffer from rust disease), radishes

- Garden-beets

 - Perfect for potato growing areas – not very large roots (maximum size of 10 cm) are desired

- Lettuce, spinach, peas

DO NOT GROW: beans, fruit bearing vegetables, early cole crops, parsley (rust disease)

Suburban growing area

- A town with a population of 100,000, the surroundings of 20 km
- **Vegetables for direct consumption** – better sales (fresh vegetable tops)
- Vegetables that are **difficult to distribute and store**
 - Lettuce, small radishes with the tops, green onions, bundled carrots, etc.

Farmers do not grow only small radishes – growing small radishes entails high labour demands – they also grow other vegetables

REQUIREMENTS OF VEGETABLES FOR MANURING

Heavy feeders

- Full amount of stable manure (25-40 t) or other organic fertilisers (commercial compost)
- Ideally fertilise **half** the beds with organic fertilisers – nowadays, this is unrealistic
- Low numbers of livestock – a maximum of 1/3 of the land is nowadays fertilised

Cole crops, fruit bearing vegetables, celeriac, leeks

Medium feeders

- Mineral fertilisation (NPK + Mg)
- **Root vegetables, green vegetables, onion vegetables, tomatoes (humus-rich soils)**

Light feeders

- Additional mineral fertilisation (according to the soil analysis)

Peas, beans, spinach, onions (humus-rich soils)

Peppers and cucumbers

- Need of manuring
- Roots set in the top soil layer – the plants are shallow-rooted, setting the roots 15-20 cm deep, spreading the roots rather than rooting to a depth
- Peppers have a weak root system being of only a quarter of the size of the tomato root system, peppers need to have water-holding organic matter in the top soil layer (otherwise, water cannot be retained)
- When lacking water, cucumbers and peppers shed flowers

Tomatoes

They can be grown on humus-rich soils (more than 3% of humus) needing no manure fertilisation, but only mineral fertilisation

Celeriac

- At the initial development stage, its roots only spread horizontally, otherwise it suffers (a marsh plant)
- As the celeriac is forming the tuber, the roots start growing into a greater depth and the celeriac does not demand much; but up to this point, it needs moisture retained by **humus**

Leeks

- Leeks have the largest demands for fertilisation if they are to yield satisfactorily
- They will not yield enough on a soil fertilised only with mineral fertilisers

They have a robust root system and draw as much substances from the soil as possible (they would deplete the soil)

Early cole crops

- Early cabbage, early kale, early cauliflower, etc.
- ***No need of manuring – a short growing period***

Late cabbage behaves differently – if it is not fertilised with manure, the yield drops from 90 t to 50 t

Carrots planted in soil fertilised with manure will be cracking

Parsley – diseases

Beetroots – An accumulation of nitrates – no root vegetable is fit to be planted as a heavy feeder

Garlic and onions – if grown as heavy feeders, the storability is very poor and the yield is lower

Spinach accumulates nitrates; a 2-month growing period; five times as much nitrogen was used in the past, nowadays, the yield depends on the plant population

It is unfortunate that more vegetables cannot be grown as light feeders as it would be more profitable

Eradicating Weeds

- Undesirable plants that reduce the yield
- Competition: light, space, nutrients, water
- Difficulties when using machinery



➤ PREVENTION

- **A system of crop rotation**
 - Focus the fight against weeds on fields with densely sown grain crops or closely sown fodder crops; green manuring
 - **Seed-bed preparation** – harrowing with network harrows
 - **Cultivation of soil during the growing period** – hoeing
 - Sowing **catch crops** after the harvest of the main crop
 - **Eradication of sporadic summer weeds** that seed heavily (goosefoot, amaranth)
 - Rule – **plant on tidy, weeded land**
- One year in advance, check the cadastre and see which kinds of weed are prevailing, get and use the most suitable herbicide, usually the one against weeds that seed heavily (Goosefoot, amaranth)

➤ CHEMICAL PROTECTION

- Plant in flawlessly **prepared soil**
- Accelerated growth, closed stand = suppression of weeds
- **Choose one optimum herbicide**
(Herbicides used to be cheap, they are ten times more expensive now)
- Application at the most convenient **time** with regard to the development stage of weeds

Drawbacks of Crop Rotations

- **Root and tuber crops infested with weeds** are succeeded by vegetables that create favourable conditions for the growth of weeds
- (E.g. onions, carrots, parsley)

- Frequent growing of **brassicas** at too short intervals (50% of rape on the nearby fields – pests transfer to the vegetables)

- Only exceptionally are **catch crops** for green manure grown, brassicas prevail (the cheapest seed)

- **Anti-erosion measures:** plough in mixtures or phacelia only in the spring
- Repeated **application of herbicides** (no repeated application of Gramoxone)
- Dosing herbicides without regard to the soil type and soil group (Alanarp L 9-25 l/ha)

Vegetable Crop Rotations (Intensive)

1. Early brassicas – late cauliflower **

Early brassicas are harvested in the second half of May, cauliflower should be planted before the middle of June

2. Bundled early carrots – savoy

Early carrots are sown at the beginning of March and are harvested at the end of May, savoy should be planted before the end of June

3. Onions – crop mixture for green manuring + manuring

Onions are sown at the beginning of March and harvested at the end of July, a mixture can be conveniently produced

4. Cucumbers**

Cucumbers are sown at the beginning of May and harvested at the end of September

5. Early cabbage – leeks

Cabbage is planted in the middle of March and harvested in the middle of May, leeks are planted in June

6. Beans – spinach + manuring

Beans sown at the end of April, harvested in July,
spinach sown at the end of August – harvested in the middle of May

**** Manuring beneath the crop in the autumn**

1. Cucumbers**
2. Early cauliflower, late cabbage
3. Lettuce, tomatoes
4. Pod beans, summer crop mixture
5. Lettuce, late kale**
6. Carrots + parsley
7. Onions, crop mixture

- 1.-2. Clover forage
3. Early cabbage, late cauliflower
4. Cucumbers + tomatoes**
5. Root vegetables
6. Pod peas
7. Spring crops with clover forage underseeing

- 1.-2. Clover
3. Early cabbage, late kale
4. Lettuce, cucumbers**
5. Late broccoli
6. Onions, spinach
7. Spring crops with underseeing

Two Crops in One Year

Early kohlrabi	Celeriac
Early cauliflower	Late cabbage
Early lettuce	Tomatoes
Spinach	Tomatoes
Beans	Summer lettuce
Spinach	Cauliflower
Winter crop mixture	Tomatoes
Winter crop mixture	Late cabbage, cauliflower
Spinach	Summer crop mixture
Winter crop mixture	Lettuce, spinach
Early cauliflower	Leeks
Early kohlrabi	Radishes
Early cabbage	Early carrots
Early potatoes	Late cabbage
Early potatoes	Cucumbers

Three Crops in One Year

Small radishes	Cauliflower	Lettuce for wintering
Early lettuce	Tomatoes	Winter endive
Spinach	Beans	Iceberg lettuce
Radishes	Tomatoes	Lettuce
Small radishes	Tomatoes	Kale for wintering

	leden			únor			březen			duben			květen			červen			červenec			srpen			září			říjen			listopad			prosinec		
Brokolice pozdní	I.			II.			III.			IV.			V.			VI.			VII.			VIII.			IX.			X.			XI.			XII.		
Brokolice raná Brukev raná	I.			II.			III.			IV.			V.			VI.			VII.			VIII.			IX.			X.			XI.			XII.		
Brukev letní	I.			II.			III.			IV.			V.			VI.			VII.			VIII.			IX.			X.			XI.			XII.		
Brukev pozdní	I.			II.			III.			IV.			V.			VI.			VII.			VIII.			IX.			X.			XI.			XII.		
Brukev raná - podzimní	I.			II.			III.			IV.			V.			VI.			VII.			VIII.			IX.			X.			XI.			XII.		
Celer bulvový	I.			II.			III.			IV.			V.			VI.			VII.			VIII.			IX.			X.			XI.			XII.		
Celer řapíkatý	I.			II.			III.			IV.			V.			VI.			VII.			VIII.			IX.			X.			XI.			XII.		
Cibule ze semene	I.			II.			III.			IV.			V.			VI.			VII.			VIII.			IX.			X.			XI.			XII.		
Cibule ze sazečky	I.			II.			III.			IV.			V.			VI.			VII.			VIII.			IX.			X.			XI.			XII.		
Čekanka zelená	I.			II.			III.			IV.			V.			VI.			VII.			VIII.			IX.			X.			XI.			XII.		
Čekanka červená	I.			II.			III.			IV.			V.			VI.			VII.			VIII.			IX.			X.			XI.			XII.		
Čekanka puky	I.			II.			III.			IV.			V.			VI.			VII.			VIII.			IX.			X.			XI.			XII.		
Černý kořen	I.			II.			III.			IV.			V.			VI.			VII.			VIII.			IX.			X.			XI.			XII.		
Česnek zimní	I.			II.			III.			IV.			V.			VI.			VII.			VIII.			IX.			X.			XI.			XII.		
Česnek jarní	I.			II.			III.			IV.			V.			VI.			VII.			VIII.			IX.			X.			XI.			XII.		
Fazol keříčkový	I.			II.			III.			IV.			V.			VI.			VII.			VIII.			IX.			X.			XI.			XII.		
Fenykl	I.			II.			III.			IV.			V.			VI.			VII.			VIII.			IX.			X.			XI.			XII.		
Hrách dřeňový	I.			II.			III.			IV.			V.			VI.			VII.			VIII.			IX.			X.			XI.			XII.		

Kapusta hlávková raná	I.		II.		III.		IV.		V.		VI.		VII.		VIII.		IX.		X.		XI.		XII.
Kapusta hlávková letní	I.		II.		III.		IV.		V.		VI.		VII.		VIII.		IX.		X.		XI.		XII.
Kapusta hlávková pozdní	I.		II.		III.		IV.		V.		VI.		VII.		VIII.		IX.		X.		XI.		XII.
Kapusta k přezimování	I.		II.		III.		IV.		V.		VI.		VII.		VIII.		IX.		X.		XI.		XII.
Kapusta kadeřavá SB	I.		II.		III.		IV.		V.		VI.		VII.		VIII.		IX.		X.		XI.		XII.
Kapusta kadeřavá V	I.		II.		III.		IV.		V.		VI.		VII.		VIII.		IX.		X.		XI.		XII.
Kapusta růžičková SB	I.		II.		III.		IV.		V.		VI.		VII.		VIII.		IX.		X.		XI.		XII.
Kapusta růžičková V	I.		II.		III.		IV.		V.		VI.		VII.		VIII.		IX.		X.		XI.		XII.
Květák raný	I.		II.		III.		IV.		V.		VI.		VII.		VIII.		IX.		X.		XI.		XII.
Květák letní	I.		II.		III.		IV.		V.		VI.		VII.		VIII.		IX.		X.		XI.		XII.
Květák pozdní	I.		II.		III.		IV.		V.		VI.		VII.		VIII.		IX.		X.		XI.		XII.
Květák letní, podzimní V	I.		II.		III.		IV.		V.		VI.		VII.		VIII.		IX.		X.		XI.		XII.
Lilek	I.		II.		III.		IV.		V.		VI.		VII.		VIII.		IX.		X.		XI.		XII.
Mangold	I.		II.		III.		IV.		V.		VI.		VII.		VIII.		IX.		X.		XI.		XII.
Meloun pravý	I.		II.		III.		IV.		V.		VI.		VII.		VIII.		IX.		X.		XI.		XII.
Meloun vodní	I.		II.		III.		IV.		V.		VI.		VII.		VIII.		IX.		X.		XI.		XII.
Mrkev raná	I.		II.		III.		IV.		V.		VI.		VII.		VIII.		IX.		X.		XI.		XII.
Mrkev raná podzimní	I.		II.		III.		IV.		V.		VI.		VII.		VIII.		IX.		X.		XI.		XII.
Mrkev pozdní	I.		II.		III.		IV.		V.		VI.		VII.		VIII.		IX.		X.		XI.		XII.

Okurky nakladačky	I.			II.				III.			IV.			V.		VI.		VII.		VIII.		IX.		X.		XI.		XII.
Okurky salátovky	I.			II.				III.			IV.			V.		VI.		VII.		VIII.		IX.		X.		XI.		XII.
Paprika	I.			II.				III.			IV.			V.		VI.		VII.		VIII.		IX.		X.		XI.		XII.
Pastinák	I.			II.				III.			IV.			V.		VI.		VII.		VIII.		IX.		X.		XI.		XII.
Pažitka	I.			II.				III.			IV.			V.		VI.		VII.		VIII.		IX.		X.		XI.		XII.
Petržel kořenová	I.			II.				III.			IV.			V.		VI.		VII.		VIII.		IX.		X.		XI.		XII.
Petržel nařová	I.			II.				III.			IV.			V.		VI.		VII.		VIII.		IX.		X.		XI.		XII.
Pór letní	I.			II.				III.			IV.			V.		VI.		VII.		VIII.		IX.		X.		XI.		XII.
Pór podzimní	I.			II.				III.			IV.			V.		VI.		VII.		VIII.		IX.		X.		XI.		XII.
Pór zimní	I.			II.				III.			IV.			V.		VI.		VII.		VIII.		IX.		X.		XI.		XII.
Rajčata keříčková	I.			II.				III.			IV.			V.		VI.		VII.		VIII.		IX.		X.		XI.		XII.
Rajčata tyčková	I.			II.				III.			IV.			V.		VI.		VII.		VIII.		IX.		X.		XI.		XII.
Rajčata keříčková V	I.			II.				III.			IV.			V.		VI.		VII.		VIII.		IX.		X.		XI.		XII.
Reveň	I.			II.				III.			IV.			V.		VI.		VII.		VIII.		IX.		X.		XI.		XII.
Ředkev jarní	I.			II.				III.			IV.			V.		VI.		VII.		VIII.		IX.		X.		XI.		XII.
Ředkev letní	I.			II.				III.			IV.			V.		VI.		VII.		VIII.		IX.		X.		XI.		XII.
Ředkev zimní	I.			II.				III.			IV.			V.		VI.		VII.		VIII.		IX.		X.		XI.		XII.
Ředkvička	I.			II.				III.			IV.			V.		VI.		VII.		VIII.		IX.		X.		XI.		XII.
Řepa salátová	I.			II.				III.			IV.			V.		VI.		VII.		VIII.		IX.		X.		XI.		XII.

Salát raný	I.			II.		III.			IV.		V.		VI.		VII.		VIII.		IX.		X.		XI.		XII.
Salát letní	I.			II.		III.			IV.		V.		VI.		VII.		VIII.		IX.		X.		XI.		XII.
Salát podzimní	I.			II.		III.			IV.		V.		VI.		VII.		VIII.		IX.		X.		XI.		XII.
Salát zimní	I.			II.		III.			IV.		V.		VI.		VII.		VIII.		IX.		X.		XI.		XII.
Špenát jarní	I.			II.		III.			IV.		V.		VI.		VII.		VIII.		IX.		X.		XI.		XII.
Špenát pozdní	I.			II.		III.			IV.		V.		VI.		VII.		VIII.		IX.		X.		XI.		XII.
Špenát k přezimování	I.			II.		III.			IV.		V.		VI.		VII.		VIII.		IX.		X.		XI.		XII.
Špenát novozélandský	I.			II.		III.			IV.		V.		VI.		VII.		VIII.		IX.		X.		XI.		XII.
Štěrbák raný	I.			II.		III.			IV.		V.		VI.		VII.		VIII.		IX.		X.		XI.		XII.
Štěrbák letní	I.			II.		III.			IV.		V.		VI.		VII.		VIII.		IX.		X.		XI.		XII.
Štěrbák pozdní	I.			II.		III.			IV.		V.		VI.		VII.		VIII.		IX.		X.		XI.		XII.
Štěrbák přezimující	I.			II.		III.			IV.		V.		VI.		VII.		VIII.		IX.		X.		XI.		XII.
Tykev	I.			II.		III.			IV.		V.		VI.		VII.		VIII.		IX.		X.		XI.		XII.
Tykev patisony	I.			II.		III.			IV.		V.		VI.		VII.		VIII.		IX.		X.		XI.		XII.
Vodnice	I.			II.		III.			IV.		V.		VI.		VII.		VIII.		IX.		X.		XI.		XII.
Zelí rané	I.			II.		III.			IV.		V.		VI.		VII.		VIII.		IX.		X.		XI.		XII.
Zelí letní	I.			II.		III.			IV.		V.		VI.		VII.		VIII.		IX.		X.		XI.		XII.
Zelí pozdní	I.			II.		III.			IV.		V.		VI.		VII.		VIII.		IX.		X.		XI.		XII.
Pekingské zelí	I.			II.		III.			IV.		V.		VI.		VII.		VIII.		IX.		X.		XI.		XII.
Čínské zelí	I.			II.		III.			IV.		V.		VI.		VII.		VIII.		IX.		X.		XI.		XII.