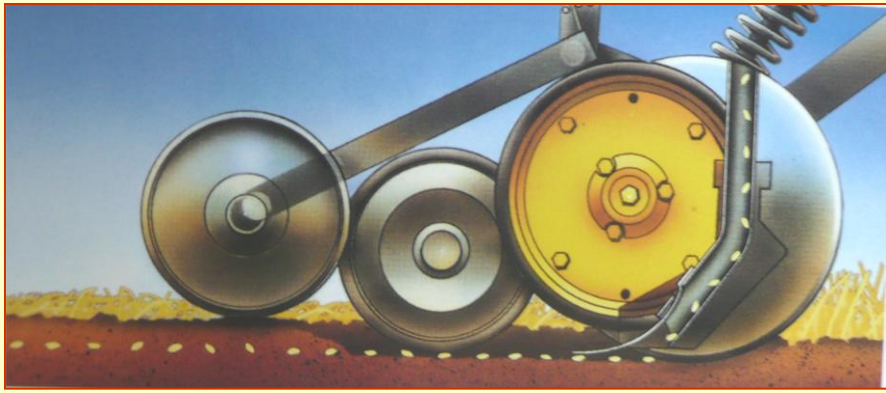
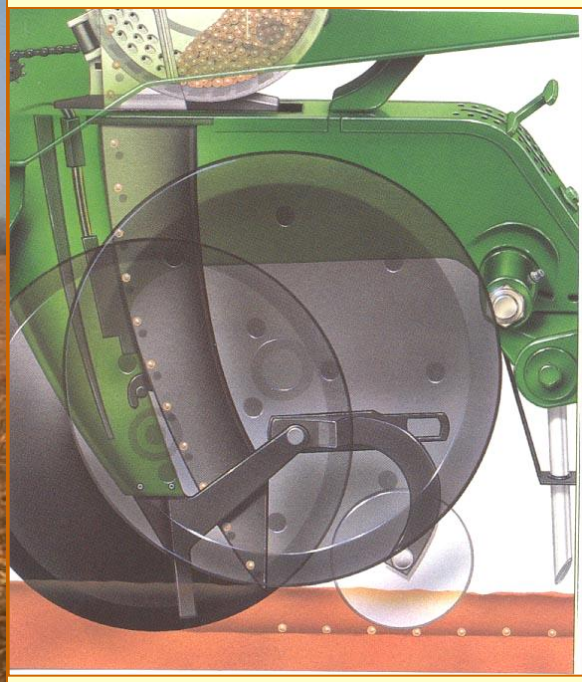
Direct drilling

Sowing seeds in untilled soil, with a special drill equipped with planting shoes. Soil disturbance takes place only in the sowing line – in cutting the seed furrow open – affecting not more than about 10 % of the soil surface

1. The '**seedbed**' is a seed furrow **opened by the planting shoe of the DD machine and which is then covered with soil by the consolidating elements.**
2. **In an undisturbed soil it is the planting coulter and the consolidating element of the DD machine that create the condition required for quick germination and emerging.**
3. **The plant growth depends on the extent to which the requirements of growth are met by the soil condition.**





Direct drilling is a low intensity mode of cropping

Factors to be taken into consideration in relation to DD

1. **Stubble residues in the surface**. **Allelopathy** (plants' mutual negative impacts on one another) **and inhibition of germination may appear**

2. **Pests and pathogens. More damage should be expected particularly in the first years – precise timing of chemical crop protection is crucial** (**from 5th - 6th year biological balance is developed**).

3. **Cold soil in spring – but advantageous in a hot growing season**

4. **Crop sequence. Monoculture is risky. Changing the crops grown in a field from time to time is also indispensable for the purposes of controlling pests, pathogens and weeds**

5. **Soil physical state**. During the first years of the DD, settling – which is typical phenomenon in conventional tillage – should be expected, which may be alleviated in advance, by loosening the soil

6. **Loosen state is required to a depth of 40 cm – A compacted root zone = DD application risk.**

Factors to be taken into consideration in relation to DD

7. **Soil fertility. The top layer will grow richer and the root zone will poorer in nutrients**

8. **Microbial activity**. Settled soil is short of air, has a higher moisture content is favourable for anaerobic processes and the build-up of root poisons

9. **Weeds. Chemical crop protection is indispensable in a DD system (scorching before sowing and selective herbicide before or during sowing). Crop residues reduce the effect, but keep chemicals in place**

10. **Fertilising** – rates of utilisation may be lower, but **a number of effective technological solutions have been developed** in line with the types of DD machines and the types of the chemicals themselves

11. **Machine requirement**: **Combination**: **opening seeding furrow, placing seeds, covering seeds, delivering fertilisers and chemicals**

12. **Economic efficiency: undermined by the loss of produce and the costs of crop protection**

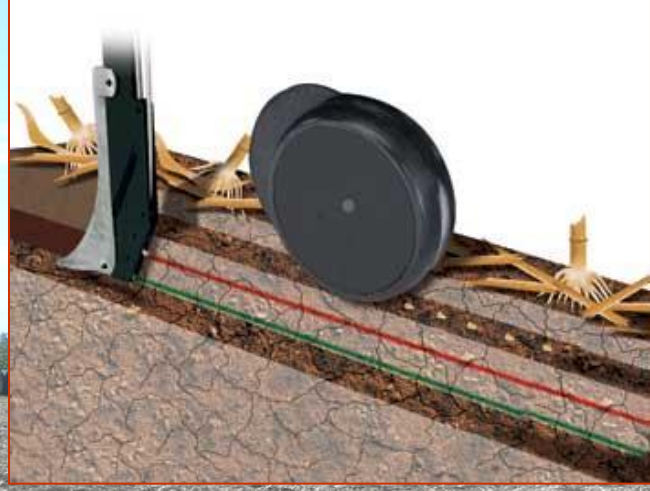
13. **Expertise – Learn about the benefits and the expected risks, and must alleviate the risks**

Tillage/sowing systems in wet soil (for w. wheat)

Conventional	Reduced	DD
Stubble tillage by disk/noting (+)	**Stubble tillage** by cultivator (-)	**Stalk chopping (0)** **(may leave off)**
↓	↓	↓
Primary tillage: Conv. plough + tine harrow (+)	**Primary tillage:** **Cultivator (-)**	**Chemical stubble treatment (0)**
↓	↓	↓
Surface levelling disk + roll (+)	**Seedbed preparation + sowing (-)**	**DD chemicals, fertilisation, herbicides dispense (-)**
↓		
Seedbed preparation: combinator (-)		
↓		
Sowing: conventional drill (+)		
Impact on soil: unfavourable	**Impact on soil: favourable**	**Impact on soil: favourable (?)**
Legend: possible damage (+); minimised damage (-), neutral (0)		

Tillage and plant

Strip-till (tillage and sowing in strips). The soil in the sowing strip is loosened and the crop residues are pushed aside between the rows. Strip tillage may precede sowing and it may work the soil deeper than the sowing depth. It may even involve loosening the compact layer that has been found in the soil.



Strip tillage may work the soil deeper than the sowing depth

Strip-till rape (preceding crop seed corn)

Further recommendations

Sowing methods adaptability on *wet* soil

Sowing method	Agronomical advantages	Probable risks
CONVENTIONAL (in ploughed soil)	Better soil condition under spring crops	Soil condition harms and sowing defects in any seasons
CONVENTIONAL (in soil tilled ploughless)	Better soil condition under spring crops	Unsuitable planting tool on mulched surface
SEEDBED PREPARATION and SOWING (in one pass)	Less compaction and less puddling harms in any seasons	Soil condition defects occurred during primary tillage may be improved to sowing depth only
TILL and PLANT (shallow variant; untilled stubble)	Less compaction and less soil structure deterioration	Soil condition defects were occurred earlier cannot be alleviated
TILL and PLANT (shallow variant; tilled stubble)	Less trafficked area and other damage	Earlier soil condition defects cannot be alleviated
STRIP TILL and PLANT	Less trafficked area and other damage	Compaction in deeper layer; Heavy weed infestation
RIDGE TILL and PLANT	Soil deterioration in trafficked lines only	Proper management of sloped area is required
DIRECT DRILLING	Less compaction /smearing defects	State of deeper soil layers requires more attention

Other advices for dry soils /seasons

1. **Stubble tillage:** shallowly, create pressed, mulched surface
2. **Stubble treatment** – chemically (new mulch!)
3. **Soil state assessment**
4. **Deepening active soil layer** – gradually
5. **No water loss, no create clods**
6. **Soil loosening (crumbling) + pressing**
7. **Depth of p. tillage – as soil assessment suggested**
8. **Surface preparation: creating water and C conserving surface**
9. **Seedbed preparation with less disturbance (no create dust)**
10. **Create soil state adaptable to water intake and water retention**

Practical standpoints of the drought threat mitigating tillage

1) Knowledge of the depth of the loosened soil layer to draw conclusions concerning the likely damage (minor, medium, great).

2) Preventing the development of compaction impeding water transport. Water that cannot seep into the soil will never be utilised by crops.

3) Eliminating the compact layer in the soil with the aid of a suitable tillage technique.

4) Preserving the soil organic carbon is crucial using any type of tillage and in any part of the year.

5) Covering the surface in critical months with crushed field residues to protect soil and soil moisture.

Practical standpoints of the drought threat mitigating tillage

6) Creating small „water loss” surface in any season, without compaction stress.

7) Protecting the soil structure using any type of tillage.

8) Use the most suitable primary/secondary tillage method/tool in any season.

9) Using tools causing smaller stress in over wet or dry or moist soils.

10) In the case of regular irrigation particular attention is to be paid to maintaining the soil’s capacity to take in and to store water.

Ten commandment for soil remedy following water-logging

1. **Most important is alleviation of damages – No cause new damages, no worsen the existing soil defects**.
2. **Clod formation, kneading are prohibited (which limit regeneration!)**
3. **Moderate the traffics**: disturb soils in the workable state.
4. **Create good state for deeper tillage by mulching stubble tillage.**
5. **Loose pan layers in dry but non-desiccated soils.**
6. **Deepen the soil gradually**: shallow stubble tillage, treatment slightly deeper, panalleviating primary tillage.
7. **Prolong the time of surface conservation by ploughless tillage.**
8. **OM and C conservation in every tillage step** (required disturbance – yes, damaging or unnecessary - no).
9. **Soil structure conservation in every tillage step.**
10. **Soil condition assessment in the fields – on stubbles, following primary tillage and sowing, and in crop stocks.**

Definitions

Energy-efficient tillage

Soil condition – meeting the requirements of the crop to be produced – is created with the aid of minimised numbers of tillage techniques and the smallest possible number of tillage passes.

Preserving tillage

No additional damage is done to the soil or its physical and biological condition is even improved while creating conditions to meet the requirements of the crop to be produced.

Adaptable tillage

Improving or conserving the quality of soil in harmony with site (environment), mechanisation and farming conditions. Creating a soil condition for cropping through alleviating harmful climate impacts.

Duties for soils and environment

1. Knowledge in soil condition
2. Soil state preserving and improving
3. Preserving soil moisture
4. Preserving and increasing soil OM content
5. Preserving and remedying soil structure
6. Maintain a favourable soil biological activity
7. Upper 6 points: Climate damage mitigation
8. Environment and landscape preservation
9. Reasonable cost saving
10. Learn, train and teach

Thank you for your attention

Děkuji Vam za pozornost