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# OPTIMIZATION OF AGRICULTURAL TECHNOLOGIES FOR THE PREPARATION OF THE GERMINATIVE BED IN EXPERIMENTAL FIELDS AND SMALL INDIVIDUAL FARMS

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***Abstract:*** *The preparation of the germination bed for sowing or planting consists in mobilizing, crushing and loosening the soil to an equal depth or 1-2 cm greater than the depth of sowing or planting, which ensures optimal conditions of humidity, light and heat for germination and uniform seed germination or development of planted seedlings.*
*The work of preparing the germination bed has a special importance in the technology of plant cultivation in order to obtain the desired result both in terms of quantity and quality. Climate change in recent years has shown that there is a need for detailed studies on how to prepare the germination bed and the equipment that performs this work in order to obtain high production, but at the same time to conserve soil resources. As a result, it is necessary to choose the best soil tillage variant to obtain a germination bed that ensures the optimal conditions for plant growth and development. By testing the different soil tillage systems, conventional and conservative, the effects produced on the soil properties and on the qualitative work indices when preparing the germination bed are taken into account.*
*This paper aims at a comparative study between conventional and conservative agricultural technologies and their optimization in the specific conditions of experimental fields and small individual households.*
***Keywords****: agricultural technologies, germination bed, experimental field, individual households*

## 1. INTRODUCTION

The germination bed has a particularly high impact on the entire vegetation period of the cultivated plants. In experimental fields and small individual households, the preparation of the germination bed can be done through both technologies specific to conventional agriculture and conservative agriculture [4]. The establishment of the system of works for the preparation of the germination bed is the result of a complex of factors: the crop plant, the pedoclimatic conditions, the range of existing agricultural machines, the soil humidity etc. Thus, the chosen technology must ensure the good development of agricultural crops, soil conservation and conditions of economic efficiency [5].
The technology of preparing the germination bed in the conditions of conventional agriculture involves two categories of soil works: primary and secondary. The primary tillage of the soil is done by ploughing with the total or partial turning of the furrow. It is effective for weed control by deeply incorporating their roots and plant debris [6]. The secondary work is carried out after ploughing and consists in the fragmentation, crushing of lumps and structural macro aggregates in the soil in order to achieve a uniform surface. It consists of several operations in relation to the type of soil, the cultivated plant and the range of machines used [8], [9].
The technology of preparing the germination bed in the conditions of conservative agriculture is based on the less intense loosening of the soil, without the return of the furrow and only in the conditions of keeping at the surface of the soil a certain amount of vegetal residues [7].

## 2. MATERIAL AND METHOD

**Technological sheet no.1**

*Name of the technology:* **CONVENTIONAL GERMINATING BED PREPARATION SYSTEM WITH MOLDBOARD PLOW + DISC HARROW, MOLDBOARD PLOW + COMBINATOR OR MOLDBOARD PLOW + AGRICULTURAL MILLING MACHINE**

The plow makes the total or partial turn of the furrow. It contributes to the destruction of weeds by incorporating them into the soil at depth and destroying them during the vegetation period by mechanical works [1]. It also allows good control of diseases and pests, by deeply incorporating various pathogens.

**Technical presentation**

| | | |
|---|---|---|
| 1. | Field conditions | ➢ soils with a good structure, loam-sandy, loamy or loam-clay<br>➢ plant residues in a small proportion on the ground |
| 2. | The crops to which it is recommended | ➢ wheat<br>➢ corn<br>➢ soybean<br>➢ beans<br>➢ vegetables<br>➢ sunflower;<br>➢ sugar beet |
| 3. | Soil works | **Basic work**: with mouldboard plough at a depth of 18-30 cm; the soil is loosened by turning the furrow; the work is performed after harvesting the preceding plant; the optimum working humidity is 50-60% of the active humidity range<br>**Germination bed preparation works**: with disc harrow, combinator or agricultural milling machine on the day or pre-sowing; the working depth is the sowing depth, maximum 1-2 cm deeper; the working direction is perpendicular to the direction of the basic work |
| 4. | Advantages | ➢ allows loosening and mobilization of the soil to the surface and reducing short-term compaction<br>➢ after the application of the ploughing, practically through a single work, favourable conditions are created on the surface regarding the infiltration of water in the soil for short periods of time<br>➢ in non-industrialized, poorly developed areas the unskilled labour force employed in conventional agriculture is very large, thus solving various social problems |
| 5. | Observations | ➢ the large number of “entrances” on the soil, especially in unsatisfactory conditions in terms of humidity, leads in the long run to the increased risk of deep soil compaction<br>➢ the total return of the furrow that can bring to the surface soil layers with unfavourable physical and chemical characteristics and that have immediate negative consequences on the germination, emergence, growth and development of plants in the first phases of vegetation<br>➢ the preparation period of the germination bed is longer, due to the large number of necessary works, thus determining the delay of sowing |

**Technological sheet no.2**

*Name of the technology:* **CONSERVATIVE SYSTEM FOR PREPARING THE GERMINATIVE BED WITH PARAPLOW + ROTARY PED**

The paraplow plough processes the soil without turning the furrow, keeping the plant residues in a proportion of 15-30% at the soil surface or incorporating them superficially, fulfilling the role of mulch. This technology reduces soil compaction, ensures water conservation and stops the loss of humidified organic matter [2].

**Technical presentation**

| | | |
|---|---|---|
| 1. | Field conditions | ➢ soils with a good structure, loam-sandy, loamy or loam-clay<br>➢ vegetable residues in a proportion of 15-30% well chopped |
| 2. | The crops to which it is recommended | ➢ wheat<br>➢ corn<br>➢ soybean<br>➢ beans |
| 3. | Soil works | **Basic work:** with paraplow at a depth of 22-25 cm (maximum 30 cm); the soil is loosened without turning the furrow; the work is performed immediately after harvesting the preceding plant; the optimum working humidity is 50-60% of the active humidity range<br>**Germination bed preparation works:** with rotary harrow on the day or before sowing; the working depth is the sowing depth, maximum 1-2 cm deeper; the working direction is perpendicular to the direction of the basic work |
| 4. | Advantages | ➢ after three years of application of the technology with paraplow + rotary harrow the soil structure improves and also the agro physical, agrochemical and agro biological properties of the soil enhancing its fertility<br>➢ the obtained productions are close to those obtained in the classical technology: classic plough + disc 2 passes |
| 5. | Observations | ➢ in the first years of application on soils with destroyed structure there is a tendency of soil compaction on the depth of 10-25 cm<br>➢ once every 4 years it is recommended to apply in rotation the classic technology with plough. |

**Technological sheet no.3**

*Name of the technology:* **CONSERVATIVE SOIL WORKING SYSTEM WITH CHISEL + ROTARY HARROW**

The chisel processes the soil to a depth of 18-22 cm (maximum 40 cm) without overturning the furrow, causing fragmentation, crushing and loosening of the soil. The vegetal remains are preserved in a proportion of 15-30%, at the surface of the soil being superficially incorporated by the executed works, fulfilling the role of mulch. This technology reduces soil erosion, ensures water conservation in the soil and reduces soil compaction [2], [3].

**Technical presentation**

| | | |
|---|---|---|
| 1. | Field conditions | ➢ soils with a good structure, loam-sandy, loamy or loam-clay<br>➢ vegetable residues in a proportion of 15-30% well chopped |
| 2. | The crops to which it is recommended | ➢ wheat<br>➢ barley<br>➢ corn<br>➢ soybean<br>➢ sunflower |
| 3. | Soil works | **Basic work:** with chisel at a depth of 16-22 cm; the soil is loosened without turning the furrow; the work is performed immediately after harvesting the preceding plant; the optimum working humidity is 40-50% of the active humidity range,<br>**Germination bed preparation works:** with rotary harrow on the day or the day before sowing; the working depth is the sowing depth, maximum 1-2 cm deeper; the working direction is perpendicular to the direction of the basic work |
| 4. | Advantages | ➢ after three years of application of the technology with chisel + rotary harrow, the soil structure is improved and also the agro physical, agrochemical and agro biological properties of the soil, enhancing its fertility<br>➢ the obtained productions are close to those obtained in the classical technology: classic plough + disc 2 passes<br>➢ the economic efficiency during the crop rotation is higher compared to the classic technology |
| 5. | Observations | ➢ in the first years of application on soils with destroyed structure there is a tendency of soil compaction on the depth of 10-25 cm<br>➢ once every 4 years it is recommended to apply in rotation the classic technology with plough |

**Technological sheet no.4**

*Name of the technology:* **CONSERVATIVE SOIL WORKING SYSTEM WITH COMPLEX AGGREGATE WITH ROTARY STAFF**

The system of minimum works with rotary harrows and complex aggregates with rotary harrows, with horizontal or vertical rotor, is the most used variant in Eastern and South-Eastern Europe. The rotary harrow is a combined machine, operated from the tractor to perform a horizontal or vertical rotational movement of its active parts, followed by the roller. After it, the ground remains crushed to a depth of 10-18 cm, levelled and settled [1], [2].

**Technical presentation**

| | | |
|---|---|---|
| 1. | Field conditions | ➢ soils with a good structure, loam-sandy, loamy or loam-clay<br>➢ vegetable residues in a proportion of 10-15% well chopped<br>➢ Avoid lands heavily infested with perennial weeds |
| 2. | The crops to which it is recommended | ➢ wheat<br>➢ barley<br>➢ colza<br>➢ soybean<br>➢ beans |
| 3. | Soil works | With rotary harrow once with the sowing; the working depth is the sowing depth, maximum 1-2 cm deeper; the optimum working humidity is 30-50% of the active humidity range |
| 4. | Advantages | ➢ after three years of application of the technology with rotary harrow the soil structure improves and also the agro physical, agrochemical and agro biological properties of the soil increasing its fertility<br>➢ the obtained productions are close to those obtained in the classical technology: classic plough + disc 2 passes<br>➢ the economic efficiency during the crop rotation is higher compared to the classic technology |
| 5. | Observations | ➢ in the first years of application on soils with destroyed structure there is a tendency of soil compaction on the depth of 10-25 cm<br>➢ once every 4 years it is recommended to apply in rotation the classic technology with plough |

## 3. RESULTS AND DISCUSSIONS

The results of agricultural technologies used in the preparation of the germination bed are expressed by qualitative work indices which represent a complex of measurable or determinable quantities with the help of measuring instruments [4]. Working indices for germinated bed preparing works characterize the degree to which the agro technical requirements imposed on the soil before sowing or planting are met.
Lands in experimental fields, but also in small individual households must meet a number of requirements: the soil must be fertile, have a thick arable layer, to be flat [7].
The most important qualitative indices of work on the preparation works of the germination bed are [4]:

- ❖ the degree of soil shredding;
- ❖ water stability of soil aggregates;
- ❖ volumetric mass of the soil;
- ❖ resistance to soil penetration;
- ❖ average working depth of the equipment for soil works;

- ❖ degree of soil loosening;
- ❖ degree of soil levelling;
- ❖ the degree of weed destruction.

**Table 1:** The indicative values of the qualitative work indices for the preparation of the germination bed [4]

| **Qualitative indices of work on basic works** | **Values** |
|---|---|
| Average deviation from the average working depth | $\delta_a \leq \pm 0{,}10\ a_m$ |
| Maximum deviation from the average working depth | $\Delta_a \leq \pm 0{,}2\ a_m$ |
| Standard deviation of working depth | $s_a \leq \pm 0{,}1\ a_m$ |
| Coefficient of variation of working depth | $C_a \leq \pm 0{,}10$ |
| Degree of soil shredding | $G_{ms} > 70\ \%$ |
| Degree of weed destruction | $G_{db} > 90\ \%$ |
| **Qualitative work indices for the preparation of the germination bed** | **Values** |
| Average deviation from the average working depth | $\delta_a \leq \pm 0{,}10\ a_m$ |
| Maximum deviation from the average working depth | $\Delta_a \leq \pm 0{,}2\ a_m$ |
| Standard deviation of working depth | $s_a \leq \pm 0{,}1\ a_m$ |
| Coefficient of variation of working depth | $C_a \leq \pm 0{,}10$ |
| Degree of soil shredding | $G_{ms} > 75\ \%$ |
| Degree of weed destruction | $G_{db} > 95\ \%$ |

$a_m$ - working depth of active organs [cm]

## 4. CONCLUSIONS

Conservative agricultural technologies have the following advantages compared to conventional agricultural technologies:

- reduces the time with soil work 2-4 times;
- fuel consumption is reduced by 30-50%;
- the number of agricultural machines per unit area is reduced;
- the soil structure is restored and its compaction is reduced;
- increases the content of organic matter in the soil;
- increases the permeability of the soil for water and improves the overall drainage of the soil;
- the vegetal remains left on the soil surface, by incorporating them, contribute to the growth of the fauna and flora in the soil;
- maintains air quality by reducing emissions from fuel combustion;

Regardless of the technology used, the realization of the soil works at the optimal humidity in order to prepare a quality germination bed is one of the first important technological conditions for obtaining a high and quality agricultural production.

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