MECHANISED TECHNOLOGY FOR GROWING AND HARVESTING CORN

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Abstract: Improvement of applied modern mechanized technologies for growing and harvesting of corn, introduction of hybrids with a low and strong stem, suitable for thicker sowing, irrigation, etc. Lead to an increase in average grain yield per hectare.
The best precursors for corn are bean cultures, peas, alfalfa etc. Keeping this crop rotation turns out to be appropriate for successful weed control. Permanent cultivation of corn is also perceived, but it should not last for more than three consecutive years on the same area. In addition, corn is also eligible for cultivation in the case of reduced soil cultivation, incl. And through direct sowing. Obviously, with these extensive opportunities for crop rotation, account should be taken of the period of natural soil compaction and of the type of soil. Production and protection is carried out by two technologies: harvesting of cobs and harvesting of grain.
The main advantages of the first technology are the following: harvesting can be done at higher grain humidity (about 30%) when the stems are still green and can be ensiled; No additional energy costs are required to dry the grain; Timely release of sowing areas for subsequent crops.
When grain maize is harvested, the development of the maturity phase and the decrease of grain moisture should be observed, as the maturity increases considerably in the harvest losses. With the prolongation of the maize harvest, the biological losses are particularly high mainly due to fallen cobs, which reach up to 25%.
With the maturity phase of corn growing, the productivity of combine harvesters’ increases, but taking into account the increase in losses, the optimal harvesting time for corn should be done on an economic basis.

KEYWORDS: MECHANIZED TECHNOLOGIES, CORN, HARVESTING, SOIL TREATMENT, TECHNOLOGICAL OPERATIONS, ECONOMIC JUSTIFICATION

Corn is mainly grown for grain, which is mainly used for fodder. The cornstalk (dry leaf mass) is used for roughage. Corn is a basic silage culture. Corn grain and some of its derived products are also used for victuals, in food and beverage industries, etc. meaning more than 150 products are produced from industrial processing. The aim of the study is to summarize the experience in the Republic of Bulgaria of the applied technologies for corn growing.

![Exemplary corn growing technology](image)

The best precursors for corn are bean cultures, basil, peas, alfalfa, fia mixture, alfalfa. Wheat and barley are good, less suitable are sunflower, sugar beet, sorghum. Observing these crop rotation turns out to be appropriate for successful weed control. Mono crop growth of corn is also perceived, but it should not last for more than three consecutive years on the same area. In addition, corn can be grown in the case of reduced soil cultivation, also through direct sowing. Obviously, with these extensive opportunities for crop rotation, the period of natural soil compaction and of the type of soil should be taken into account. Due to the broader possibilities of growing corn, two types of corn growing technology are now being developed.
The fertilization is carried out before the deep plowing by the introduction of organic phosphorus and potassium mineral fertilizers. Fertilizers are introduced by surface continuous spraying. In soils with a heavy and medium mechanical composition, ½ of the nitrogen fertilizers can be imported in autumn when the temperature is 8-10 ° C, being buried in the soil with pre-treatment (as well as phosphorus and potassium fertilizers). Under irrigation conditions, ½ of nitrogen fertilizers are introduced prior to sowing, and the remaining quantity is for foddering.
An important condition for the good result of fertilizers is their even spreading and deeper burial in the soil. Fertilizing with mineral fertilizers is done with fertilizing machines for surface dispersed fertilization. The fertilizer is transported to the field by universal means of transport.

In our climatic conditions manure is usually introduced with the main soil treatment for spring crops, including for maize. The effect of imported manure lasts for 3-4 years and the quantity depends on the type of soil and the possibility of irrigation. It is sprayed with fertilizer spreaders, which are also used to transport fertilizer from fertilizer storage to the field or through rotor sprinklers. In this case, the fertilizer is transported by universal means of transport, pouring into the piles in heaps, which are then dispersed by the specialized machines.

The liming of acidic soils improves the soil response, the soil's physical properties and the feeding regime of corn.

Good results are also obtained from fertilization with zinc (carbonate black-earth and vertisols) and molybdenum (on gray forest soils). When fertilization is not with zinc and molybdenum, permanent slurry fertilizers (leaf fertilization) may be used.

Field preparation depends on the predecessor, entangling, etc., but includes the ice treatments: deep plowing, shallow autumn weed control and spring pre-sowing treatments. The main treatment of the soil is carried out at a depth of 28-30 cm with weeding plows. In the presence of root weeds, the mechanical treatment is combined with spraying with herbicides and subsequent one, two surface treatments with disc tillage machines.

Pre-sowing treatments include harvesting and cultivation before sowing. Cultivation is done in a meld. It is preferable to use cultivators with spring stands of working bodies or combined tillage machines.

Disking is advisable when there are lumps that have to be scraped. With high chemistry, the number of treatments can be reduced depending on the physical properties of the soil and the degree of entrainment. The surface of the field should be level with well-grounded soil.

Sowing is done with the calibrated and decontaminated seeds of the most suitable for the region hybrids. The protective effect of hydrophobization lasts 40-60 days, allowing for early sowing. Recommended agro-technical sowing time for maize is from April 1 to April 20. The sowing is done in rows with spacing of 70 cm and depth a = 6 - 8 cm, the seeds in the order being 20-30 cm. Recommended seed rate for non-irrigating conditions 5000 - 6000 seeds per acre - for irrigation conditions 5500 - 7000 seeds per are ie. 1,5-2,0 kg per acre. Pneumatic seeders are used for accurate sowing.

It is advisable to spray with herbicides at the same time as sowing. For this purpose, combined sowing machines and inter-row spraying machines with herbicides are used. To save money, we can skip spraying the in between row space. Here the weeds are destroyed by mechanical processing (hoeing). The sowing of the corn as the first crop is carried out by classical technology and so-called direct sowing.

During the corn vegetation period, the following activities are carried out: fight against soil and weeds, feeding up, irrigation (in irrigation conditions) and fighting against diseases and pests. The fight against the soil crust is conducted by harrowing, using light and medium type tooth harrows and rotary harrows. It can be done both before and after emergence of 4-5 leaf of culture.

Treatments between the rows begin in phase 4, 6 and continue to 10th leaf. The depth of the first trench should not exceed 7-8 cm, and the second 4-5 cm. If the corn is irrigated without watering, the second treatment can be combined with earthing, but it is necessary to open the irrigation furrows when watering.

Destruction of weeds apart from inter-row processing is also done by using herbicides. The advantages of herbicides are that complete weed destruction is achieved throughout the crop area. The main disadvantage of this method is the pollution of production and soil with poisonous substances. The main drawback of mechanical destruction is that weed control is only achieved in the bandwidth being treated.

The most common weeds in maize crops are annual cereal and dicotyledonous weeds, rootstock species, baller, creeper pigweed, etc. for the eradication of which various herbicides and herbicide combinations are applied.

Mechanical and chemical methods for weed control should be considered as a complete interconnected plant protection system. The achievement of sustainable development and the achievement of very good yields is also achieved through work in three directions: a selective-genetic pathway, with agro technical means, by introducing and adhering to appropriate plant protection setups and treatment of the seeds with preparations. The most important diseases encountered on maize are: common cockle leaf-burn, scab and root rot, rust, molding of seeds, etc.

The integration of agro-technical, biological and chemical activities and means is a prerequisite for successful struggle against the maize pests (fig.2). The most common enemies of corn are: worms; gray corn weevil; corn borer, etc.
Irrigation is done gravitationally or by sprinkling. For gravity irrigation, flexible pipelines with deviations for each furrow are used to increase labor productivity. The flexible pipeline is connected to the distribution channel and is located across the rows, with junction hoses being routed to each furrow. The flow rate for each furrow is adjusted individually. Its magnitude is determined by the size of the longitudinal slope of the furrows, so that no water erosion of the soil occurs. Furrowing is carried out with gravitational irrigation of maize areas. It is done with cultivators, complete with grove-forming work tools.

Irrigation by sprinkling is done with sprinklers and installations. This irrigation method is effective in irrigation systems with closed pressure channels and significant field macro equilibria. There is interest in cultivation of corn under reduced soil treatment. Where prerequisites exist: suitable areas; optimal soil density; suitable herbicides; highly efficient combined machines; experience of applying reduced soil treatment within crop rotation, corn can be grown under different soil cultivation options.

The reduction of soil treatment is a reduction in soil cultivation to a degree of non-violation of the biological requirements of the plants concerned to soil density. From this point of view, the cultivation of corn by reducing soil treatment can be divided into three levels: exclusion of surface pre-sowing soil treatments; slitting pre-sowing soil treatment; complete removal of soil treatment.

In cultivation of corn as the first crop, the technology has been applied, including the operations: basic fertilizing; basic soil treatment; pre-sowing spraying with herbicides; band processing of the soil with simultaneous sowing; destruction of weeds; irrigation. In the cultivation of corn as a second crop in the precursor cereal crops, the technology mostly used includes operations involving the cleaning of the field of accumulated plant residues; Spraying with total herbicides; Batching of the soil by simultaneous sowing or sowing of the seeds directly on the untreated soil; Destruction of weeds; Irrigation. Destruction of the weeds is carried out in combination - mechanical treatment of the bumps with milling machines with simultaneous spraying of herbicides on the inter-strips. Batching of the soil with simultaneous sowing of the seeds is done by machines with combined working tools. Of all the existing combined working bodies for batching and seed sowing are the rotating tool for sub-layer row sowing and the spherical-disk working tool.

To ensure harvesting of the second crop corn irrigation is a mandatory operation. It is done as for corn as first crop. The harvest of silage corn is carried out when the grain is in a phase of milk-wax maturity and the stems are still completely green. This phase has a duration of about 10 days and the occurrence within a calendar time depends on the hybrid. The change in yield and nutritional value of the silage mass, depending on the maturity of the maize stalks, is shown in Fig.3.

![Fig.3. Change of silage mass indicators depending on degree of ripeness](image)

The harvesting of the stem corn mass with the simultaneous cutting is most effectively done by self-propelled forage harvesters. As the harvesting of the cut mass directly into the vehicles moving parallel to the combines creates some difficulties for the organization of the mass transport to the silage pits. It is considered an efficient organization of transport when using heavy-duty tractors with a servicing field tractor and serving transport tractors.

Harvesting of corn for grain is carried out by two technologies: harvesting of cobs and harvesting of grain.

The main advantages of the first technology are the following: harvesting can be done at higher grain humidity (about 30%) when the stems are still green and can be ensiled; No additional energy costs are required to dry the grain; Timely release of sowing areas for subsequent crops.

Harvesting corn cobs is carried out with corn harvesters complete with cutting machines and tearing rollers. One such combine harvester is serviced by two conveyors - for cut and for cobs. Trailers are more convenient for this purpose, as the harvester is attached to the combine itself. If the combine harvester is not equipped with a peeler, it must be provided as a stationary device at the corn-casserole where the stalks are stored.

When grain humidity is reduced to below 22% in the maturity phase of maize, it is harvested using cereal harvesters, complete with maize harvesters (adapters). The resulting grain must be dried in grain dryers.

When grain corn is harvested, the development of the maturity phase and the decrease of grain moisture should be observed, as the maturity increases considerably the storage losses. Figure 4 shows the effect of the shelf life after full maturity on grain losses. From the nature of dependencies, it can be seen that losses of free and broken grain intensively increase after 12-15 days of harvesting (from the beginning of full grain maturity). With the prolongation of the maize harvest, the biological losses mainly due to fallen cobs, which reach up to 25%, are particularly strong.

With the maturity phase of corn growing, the productivity of combine harvesters increases, but taking into account the increase in losses, the optimum harvest time for maize should be determined on an economic basis.
Losses exceed the permissible 5% after the 15th day of commencement of harvest. Assuming that direct costs of production after the 6th day remain constant, it follows that optimal earnings are obtained for 25 days from the harvest period from 20.IX. Until 15.X. Obviously, for greater accuracy in determining the optimal time, a deeper analysis of economic processes is needed. For example, changes in machine productivity, losses and costs, dependency on the harvest duration should be taken into account. The performance of the harvesters varies considerably in the harvesting process depending on the condition of the crop. In dry and fully ripened corn, the machines develop higher productivity, but with extended shelf life, losses are intensely increasing, especially biological ones.

**Fig.4 Change in losses during the harvesting period:** 1 - biological losses; 2 - broken grain; 3 - loose grain loss.

**Conclusions:**
1. In the synthesized form the basic technological inspections of the cultivation and harvesting of corn with their peculiarities are justified.
2. The typical requirements for corn cultivation and harvesting by types of technological operations are shown.

**References:**