ESTABLISHMENT OF PRESERVATION TECHNOLOGIES FOR MECHANIZATION OF SOIL WORKS AT CORN CROP, IN THE N-E AREA OF ROMANIA

STABILIREA TEHNOLOGIILOR CONSERVATIVE DE MECANIZARE A LUCRĂRILOR SOLULUI LA CULTURA PORUMB, PENTRU ZONA DE N-E A ROMÂNIEI

ȚENU I.[1], JITĂREANU G.[1], COJOCARIU P.[1], BRIA N.[2],CHIRILĂ C.[1], HONCIUC M. C.[1]

[1]University of Agricultural Sciences and Veterinary Medicine Iaşi

[2]INMA Bucureşti

Abstract. *To establish the best preservation technologies for mechanization of the soil works at corn crop, in the spring of 2007, six technological variants were carried out. During experiments, at each technological variant were determinated the quality working indexes, for each working unit, but also, energetic and exploitation indexes, at each agricultural unit. At a certain period of time after sowing were determined, at each variant, soil resistance to penetration, balanced average diameter of the soil structural elements and hydric stability of structural elements. Concomitantly, were determined at each variant the fuel consumption per hectare, for tillages and sowing. After analysing the obtained results were established the best preservation technologies for mechanization of soil works, for corn crop.*

Rezumat. *Pentru stabilirea celor mai bune tehnologii conservative de mecanizare a lucrărilor solului pentru zona de N-E a României la cultura de porumb pentru boabe, în primăvara anului 2007 s-au experimentat 6 variante de tehnologii. În cadrul încercărilor efectuate, la fiecare variantă de tehnologii s-au determinat indicii calitativi de lucru, pentru fiecare utilaj de lucru, dar şi, rezistența solului la penetrare, diametrul mediu ponderat al elementelor de structură ale solului şi stabilitatea hidrică a acestor elemente. Totodată, s-a determinat la fiecare variantă consumul de combustibil la hectar, pentru efectuarea lucrărilor solului şi semănatului. În urma analizei rezultatelor obținute la încercările efectuate s-au stabilit cele mai bune tehnologii conservative de mecanizare a lucrărilor solului, pentru cultura de porumb.*

GENERALITIES

To establish the preservation technologies for mechanization of soil works in the N-E area of Romania, at corn crop, in 2007 more technological variants were carried out.

The trial of those technologies was made in order to establish which of them are suitable in the highest grade to the concept of sustainable agriculture and will assure, first of all, protection, preservation and improvement of agricultural fields. The staff experimented five variants of unconventional technologies-

conservation of soil tillage and a sample variant, that represents the classical technology, the conventional one for soil works, used in production.

Some experimented technologies have included combine and complex working units, that have in their constitution also sowing equipments, it will be presented at all technologies also the sowing work, and in this way it will be possible acomparison between them.

MATERIAL AND METHOD

Experiments regarding mechanization technologies of soil works and sowing at corn were done in the spring and summer of 2007, on a chernozem cambic soil, with a clay content of 36% and average values of bulk density, and humidity. The longitudinal slope of the field is around 3 degrees.

At all six variant of technologies, before soil works, the vegetal mass was chopped with a SR 250 machine.

The six variants are presented in table 1.

Table 1

Variants of mechanization technologies for soil works and sowing at corn

Used units	Technological variants
• tractor Valtra T-190+Opal 140 reversible mouldboard plough (used in autumn) • tractor U-650+GD-3,2 light harrow disk+2CGR-1,7 spring-tooth harrow (2 passes, in spring) • tractor U-650+SPC-8 precise sowing machine for weeding plants (in spring) • tractor U-650+CPU-8 cultivator for weeding (2 times weeding)	V_1 (control)
• tractor U-650+PC-7 chisel (used in autumn) • tractor U-650+GD-3,2 harrow disk+2CGR-1,7 spring-tooth harrow (in spring) • tractor U-650+Vibromixt VM-251 (in spring) • tractor U-650+SPC-8 precise sowing machine (in spring) • tractor U-650+CPU-8 cultivator for weeding (2 times weeding)	V_2
• tractor U-650+PC-7 chisel (used in autumn) • tractor U-650+GD-3,2 harrow disk+2CGR-1,7 spring-tooth harrow (in spring) • tractor Valtra T-190+BS 400 complex unit(kompaktor)(in spring) • tractor U-650+SPC-8 precise sowing machine (in spring) • tractor U-650+CPU-8 cultivator for weeding (2 times weeding)	V_3
• tractor U-650+PC-7 chisel (used in autumn) • tractor U-650+complex unit (FPL-4 rotary hoe for weeding vegetables+SPC-4 precise sowing machine), in spring • tractor U-650+CPU-8 cultivator for weeding (2 times weeding)	V_4
• tractor Valtra T-190+GDG-4,2 heavy disk harrow (used in autumn) • tractor U-650+GD-3,2 harrow disk+2CGR-1,7 spring-tooth harrow (in spring) • tractor U-650+Vibromixt VM-251 (in spring)	V_5

• tractor U-650+SPC-8 precise sowing machine (in spring) • tractor U-650+CPU-8 cultivator for weeding (2 times weeding)	
• tractor Valtra T-190+GDG-4,2 heavy disk harrow (used in autumn) • tractor U-650+complex unit (FPL-4 rotary hoe for weeding legumes+SPC-4 precise sowing machine), in spring • tractor U-650+CPU-8 cultivator for weeding (2 times weeding)	V_6

Qualitative working indexes were determined, at each technological variant and for each working unit. Energetic and exploitation indexes were established, for each agricultural aggregate.

After corn sowing (at a certain period of time), at each variant, it was determined soils' penetration resistance, balanced average diameter of the soil structural elements and hydric stability of these elements. Also, at each variant, it was determined the fuel consumption per hectare for a mechanized processing of soil works and sowing.

RESULTS AND DISCUSSIONS

Important results were obtaining during experiments, regarding the above mentioned indexes. In table 2 are presented the main results that were obtained by our researches.

Table 2

Obtained results regarding works quality, soil preservation and fuel consumption

Technological variants	Quality indices for preparation of seedbed		Indices concerning conservation of soil properties.			Fuel consumption for soil works and sowing, *l/ha*
	Breakage grade of soil *%*	Loosening grade of soil , *%*	Soil penetration resistance *daN/cm²*	Balanced average diameter of soil structural elements *mm*	Hydric stability of soil structural elements *%*	
V_1 (control)	96	22	1.2	3.23	59.02	34.568
V_2	98	20	0.8	2.96	63.18	27.061
V_3	99	13	1.4	2.56	57.62	28.245
V_4	100	16	0.6	3.17	69.30	21.046
V_5	98	19	0.9	2.69	62.00	24.677
V_6	100	15	0.7	3.15	67.12	18.662

Breakage grade of soil for the seedbed preparation varied depending on the applied technology, between 96 % and 100 %. The agro-technical demands impose that at seedbed preparation, the soil breakage grade to have a minimal value of 90 %. Comparing the obtained results with the imposed demand, it finds

that the soil breakage grade is appropriate at all variants. The biggest soil breakage grade (100 %) was recorded at variants V_4 and V_6.

Soil loosening grade was suitable at all variants.

Due to the fact that we consider that the most important quality working index is breakage grade of soil, the other indexes were not presented.

Soil penetration resistance was determined at four days after corn sowing.

It must be mention the fact that, soil penetration resistance was determined from 5 to 5 cm, untill 30 cm depth. In the table, it is only presented the average value of this index on 0 – 10 cm depth, because in this area all units worked, influencing soil penetration resistance.

The agro-technical demands established many value classes for soil penetration resistance: very small = under 11 daN/cm^2, small = 11 – 25 daN/cm^2, medium = 25 – 50 daN/cm^2 etc. Comparing the obtained results with these demands, it finds that soil penetration resistance is "very small" at all variants, so it is very good.

The lowest soil penetration resistance was obtained at variants V_4 and V_6, and the highest one, at variants V_1 and V_3. The higher penetration resistance in V_3 case is due to the fact that the three rollers of BS 400 A kompaktor achieved a certain compaction of soil.

Also, the imposed agro-technical demands show the fact that at a soil penetration resistance up to 25 daN/cm^2 the roots of the plants have a normal growing. If we take in consideration these demands, we can consider that at all six variants, there are conditions for a normal growing of the corn plant roots.

Balanced average diameter of soil structural elements was determined at four months after sowing, on three deeps: 0 - 10 cm, 10 – 20 cm, 20 – 30 cm. In table are presented the values of this index on 0 – 10 cm, area in which all the units worked.

The agro-technical norms show that, from agronomic point of view, it presents a major interest in the structural elements with a 2 – 5 mm diameter. Comparing these demands with obtained results , it found that pondered average diameter of soil structural elements is proper for all variants.

At variant V_1 structural elements are the biggest, because mouldboard plough turns the processed layer of soil bringing at surface soil with a better structure (aggregates with bigger structure). In the case of variants where it was not used mouldboard plough, the higher value of balanced average diameter of soil structural elements was obtained at variants V_4 and V_6, and the lowest one at variant V_3.

Hydric stability of soil structural elements was determined, also as previous index, at four months after sowing, on three deeps: 0 – 10 cm, 10 – 20 cm, 20 - 30 cm. In table are presented the values of this index on deep 0 – 10 cm.

The agro-technical demands shows that when hydric stability of soil structural elements is higher than 60 %, this index is placed in the "extreme high" class. Comparing agro-technical demands with obtained results, it finds that hydric stability of soil structural elements is very good at variants V_4, V_6, V_2 and

V_5. The agro-technical norms established, also, that if hydric stability of soil structural elements is 40 – 60 %, the index is placed in "very high" class, it can say that hydric stability of soil structural elements is very good, in the case of variants V_1 and V_3.

The higher value of this index was recorded at variants V_4 and V_6, and the lowest one, at variants V_3 and V_1.

Fuel consumption per hectare. It was obtained by adding the fuel quantities used at mechanized tillage of soil (before sowing), at sowing and at weeding, so at all works provided at each technological variant.

If we analyse the recorded fuel consumption, we can say that this one is appropriate. The biggest fuel consumption was registered at variant V_1 and the smallest one at variants V_6 and V_4.

Establishment of the mechanization technologies for soil works which will be applied. Based on the analyse of the indexes determined at each technological variant, the variants which will be applied were established and their order.

We must specify that all six variants of mechanized technologies of soil works, experimented at corn had suitable values for quality indexes of seedbed preparation and for indexes regarding soils' features preservation. The decision in the favour of one or another variant is taken by the value of fuel consumption per hectare, but also based on the value of two kind indexes.

When there are the conditions for using preservation, unconventional, soil works systems, it can appreciate that variants which could be used, starting with the best one, are: V_6, V_4, V_5. If it isn't possible to use variant V_6 (from different reasons), it will be apply variant V_4; when even variant V_4 could not be used, will be applied variant V_5.

Could be situations in which, it is imposed to till the land with mouldboard plough. In this case, variant V_6 will applied, (or V_4) modified: basic soil work, in autumn, will be made with Opal-140 reversible mouldboard plough (it will not be used GDG-4,2 heavy disk harrow or PC-7 chisel).

CONCLUSIONS

1. After experiments and interpretation of the obtained results, the variants for mechanization technologies of soil works, at corn that are recommended to be applied in the N-E area of Romania were established.

2. In the cases in which there are conditions for using the unconventional and preserving systems of soil works, the variants of mechanized technologies for soil works which will be used, starting with the best one, are: V_6, V_4, V_5.

3. If it is imposed to till the land with mouldboard plough, it will be applied variant V_6 (or V_4) modified: in autumn, it will be used for basic soil work, Opal-140 reversible mouldboard plough (instead of heavy disk harrow or chisel).

4. It will be avoided application of variant V_1, due to the higher fuel consumption and lower values of the obtained indexes.

5. All six technological variants for mechanization of soil works and sowing, tested at corn, have suitable values of quality indexes for seedbed preparation and of indexes regarding soils' feature preservation.

6. We appreciate that variants V_4 and V_6 are much more advantageous face to the other ones, because in spring, with only one pass of the complex aggregate, formed by FPL-4 rotary hoe for weeding vegetables and SPC-4 precise sowing machine, is settled up corn crop; at the other four variants, in spring are made three passes for settling up the crop.

REFERENCES

1. **Badea G., 1980** – *Lucrările agricole şi structura solului*. Cereale şi plante tehnice, nr. 3.
2. **Canarache A, 1986** – *Cu privire la influența directă şi remanentă a lucrărilor solului asupra însuşirilor fizice ale solului.* Probleme de agrofitotehnie teoretică şi aplicată, nr. 3.
3. **Crevcenco V. şi colab, 1986** – *Tehnologii de mecanizare şi organe active noi de pregătire a terenurilor*. Cereale şi plante tehnice, nr. 40.
4. **Guş P. şi colab., 2001** – *Sisteme neconvenționale de lucrare a solului.* Edit. Risoprint, Cluj-Napoca.
5. **Jităreanu G. şi colab., 2007** – *Tehnologii şi maşini pentru mecanizarea lucrărilor solului în vederea practicării conceptului de agricultură durabilă.* Edit. Ion Ionescu de la Brad, Iaşi.
6. **Roşu Gh., 1980** – *Influența pregătirii patului germinativ pentru semănat asupra stabilității hidrice a structurii solului.* Lucrări ştiințifice, Institutul agronomic Iaşi, vol. 24, Seria Agronomie.
7. **Stănilă S. şi colab, 2003** – *Tehnici şi tehnologii de mecanizare a lucrărilor în sistem de conservare a solului*. Edit. Alma-Mater, Cluj-Napoca.
8. **Şandru A. şi colab., 1983** – *Exploatarea utilajelor agricole*. Edit. Didactică şi Pedagogică, Bucureşti.
9. **Toma Dr., Sin Gh., 1987** – *Calitatea lucrărilor agricole executate mecanizat pentru culturile de câmp*. Edit. Ceres, Bucureşti.