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

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

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Abstract. *For establishing the best preservation technologies for mechanization of soil works and sowing, at soy-bean crop, in the spring of 2007, three technological variants were carried out. At each technological variant, the quality working indexes were determined, for each working unit, but also, energetic and exploitation indexes, for each agricultural unit. At a certain period of time from sowing soy-bean crop, it was determined, at each variant the following: soil penetration resistance, balanced average diameter of the soil structural elements and hydric stability of those elements. The fuel consumption per hectare, for tillage and sowing has also been determined at each variant. Taking in consideration the results obtained during experiments, the best preservation technologies for mechanization of soil works, for soy-bean crop was established.*

Rezumat. *În vederea stabilirii celor mai bune tehnologii conservative de mecanizare a lucrărilor solului şi semănatului la cultura de soia, în primăvara anului 2007 s-au experimentat trei variante de tehnologii. La fiecare variantă s-au determinat indicii calitativi de lucru, pentru fiecare utilaj de lucru, şi indicii energetici şi de exploatare pentru fiecare agregat agricol. După o anumită perioadă de timp de la însămânţarea culturii de soia s-a determinat, pentru fiecare variantă, rezistenţa solului la penetrare, diametrul mediu ponderat al elementelor de structură ale solului şi stabilitatea hidrică a acestor elemente. S-a mai determinat, de asemenea, la fiecare variantă de tehnologii, consumul de combustibil la hectar, pentru efectuarea lucrărilor solului şi semănatului. Ţinând seama de rezultatele obţinute în cadrul experimentărilor efectuate s-a stabilit care sunt cele mai bune tehnologii conservative de mecanizare a lucrărilor solului, pentru cultura de soia.*

GENERALITIES

In years 2006 and 2007, research staff carried out experimental researches to establish which are the preservation, unconventional, technologies for mechanization of soil works and which could be applied at soy-bean crop in the N-E area of Romania.

More technological variants were tested, in order to establish which of them are suitable in the highest grade to the concept of sustainable agriculture and they will assure, first of all, protection, preservation and improvement of agricultural fields.

Each variant of mechanized technologies which includes unconventional, preservative soil works, made by adequate units will be compared with control (sample) variant, at which it is applied the classical, conventional technology for soil work, but comparison it will also be made with the other conservative technologies.

At each technological variant, we presented basic soil work, superficial maintenance works of the field, seedbed tillage, weeding works on intervals between plant rows.

Some experimental technologies used combine and complex working units, in which are included also sowing equipments. This is the reason why at all technologies, sowing work will also be present, so to be possible a comparison between them.

MATERIAL AND METHOD

Experiments regarding mechanization technologies of soil works and sowing at soy-bean started in autumn of 2006 and continued in summer of 2007. Trials were settled up on a chernozem cambic soil, with a 36% clay content and average values of bulk density and humidity. The longitudinal slope of the field was 1 – 2 degrees.

To create the most suitable conditions for tillage and sowing, at all variants of technologies, before performing these works, a SR 250 machine chopped vegetal mass

To establish the conservative technologies for mechanization of soil works and sowing, at soy-bean crop, which will be applied, we tested three technological variants. These three variants are presented in table 1.

Table 1

Variants of mechanization technologies for soil works and sowing at soy-bean

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 Valtra T-190+BS 400 A 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_2
• tractor U-650+PC-7 chisel (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_3

Variant V_1 was considered control variant, because it represents the mechanization technology for soil works and sowing which is usually applied in production; so variant V_1 is the conventional technology, the classical one for soil processing.

The qualitative working indexes were determined during experiments, at each technological variant and for each working unit; after that, the energetic and exploitation indexes were established at each variant for each agricultural aggregate.

Later, at a certain period of time from soy-bean sowing, for each variant we determined soil penetration resistance, balanced average diameter of the soil structural elements and hydric stability of these elements. After weeding of crop, fuel consumption per hectare for a mechanized processing of soil works and sowing was determined at each variant based on the values of exploitation indexes of the units,

RESULTS AND DISCUSSIONS

By making the experimental researches, interesting results were obtained regarding the previous mentioned indexes. In table 2 are presented the values of quality indexes for seedbed preparation, indexes related to soil feature preservation and fuel consumption per hectare for tillage and sowing.

Table 2

Obtained results regarding works quality, soil preservation and fuel consumption

Technological variants	**Quality indexes of seedbed preparation**		**Indexes regarding soils' features preservation**			**Fuel consumption for tillage 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	21	5.7	3.09	58.25	34.768
V_2	98	12	4.9	3.22	60.12	23.227
V_3	100	15	4.2	3.31	67.92	20.632

Breakage grade of soil at seedbed preparation. The values of this index varied very few, depending on the applied technology, from 96 % to 100 %.

As it is well know, the agro-technical demands impose that breakage grade of soil at seedbed preparation to have a minimal value of 90 %. If we compare the obtained results with the imposed demand it can observ the fact that breakage grade of soil is satisfied at all three variants. The best breakage grade of soil was recorded at variant V_3, in this case, breakage grade of soil of 100%.

Loosening grade of soil had suitable values at all three technological variants for mechanization of soil works, which placed it into the limits established by agro-technical demands. In the case of variant V_3, at which breakage grade of soil is the higher, loosening grade of soil decreases in comparison with the value obtained at variant V_1. The lowest value of loosening grade of soil was achieved at variant V_2 due to the fact that BS 400 A kompaktor has three rollers, which made a certain compaction of the soil.

From all the quality indexes of the units by which the seedbed is prepared the most important one is breakage grade of soil .From this reason, the other indexes were not presented. If problems will appear at seedbed tillage, these ones are especially caused by the fact that it is not assured a suitable soil loosening. It must be mention the fact that reducing the breakage grade of soil at values situated under the minimum limit established by agro-technical demands appears especially at seedbed preparation for crops which are sowed in autumn.

Soil penetration resistance, in the case of soy-bean crop, was determined at six days after sowing. This thing must be known, because during vegetation period, this index is increasing.

Concomitantly, we mention that soil penetration resistance was determined from 5 to 5 cm, till 30 cm depth; in table is presented only 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 observes that soil penetration resistance is very good at all variants.

The average soil penetration resistance, on 0 – 10 cm depth, varied from 4.2 and 5.7 daN/cm^2. The lowest value of this index was obtained at variant V_3, and the highest one, at variant V_1.

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 grow. Taking in consideration these demands, it could appreciate that at all technological variants for mechanization of soil works, at soy-bean crop, there are normal conditions for plant roots grow.

Balanced average diameter of soil structural elements was determined at three 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 deep, area in which all the units worked.

The agro-technical demands show, that from agronomic point of view, it presents a major interest in structural elements with a 2 – 5 mm diameter (even over 5 mm). If it will compare the obtained results with these demands, it observes that the balanced average diameter of soil structural elements is suitable at all variants.

The balanced average diameter of soil structural elements varies from 3.09 mm till 3.31 mm. The lowest value of this index is recorded at variant V_1, and the higher one, at variant V_3.

Regarding this index, we must mention an important observation: at the same time with the increasing of number of passes of the units for seedbed tillage and sowing, the diameter of soil structural elements decreases because the increasing of the passing number leads to an accelerated fragmentation process of structural elements (at variant V_1, for seedbed tillage and sowing, are made three passes of the units, while at variant V_3 is only made one pass).

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

The agro-technical demands establish that if hydric stability of soil structural elements is between 40 - 60 %, this index is placed in the "very high" class; and when this index is over 60 % could be placed in "extreme high" class. Comparing these demands with obtained results, it could say that hydric stability of soil structural elements is very good at all variants.

From the data presented in table, it observes that the lowest value of hydric stability of soil structural elements was obtained at variant V_1, and the higher one, at variant V_3.

Also, in the case of this index of soil structure, we made the same observation: at the same time with the increasing of number of passes of the units for seedbed tillage and sowing, the hydric stability of soil structural elements decreases.

Fuel consumption per hectare. This one was obtained by adding the fuel quantities used at mechanized soil works and sowing, so at all works provided in the technological variants that are the goal of our study.

We consider that, the total fuel consumption per hectare at soil works and sowing is suitable, at the three technological variants which were tested. The higher one was recorded at variant V_1 (34.768 l/ha), and the lowest one, at variant V_3 (20.632 l/ha).

Establishment of the mechanization technologies for soil works which will be applied. Analysing the indexes determined at each technological variant, we established the variants which are recommended to be applied and their order.

When there are conditions for using preservation, unconventional, soil works systems, we appreciate that the variants which could be used, starting with the best one, are: V_3, V_2. Usually, it will be applied variant V_3; but if from different reasons it could not be used variant V_3, it will be applied variant V_2.

If it is necessary to till with mouldboard plough, it will be applied variant V_3 modified: basic soil work, in autumn will be made by Opal-140 reversible mouldboard plough (will not be used PC-7 chisel).

CONCLUSIONS

1. Based on the obtained results after experiments, we established the variants for mechanization technologies of soil works and sowing, at soy-bean, which are recommended to be applied in the N-E area of Romania.

2. When there are conditions for using preservation, unconventional, soil works systems, the variants which could be used, starting with the best one, are: V_3, V_2 .

3. In the case in which mouldboard plough is imposed to use, it is strongly recommended to be applied variant V_3 modified: will be used, in autumn, for basic soil work, Opal-140 reversible mouldboard plough (instead of PC-7 chisel).

4. Even if it is necessary to use mouldboard plough, it will be avoided to apply variant V_1, due to the higher fuel consumption and lower results obtained at all other indexes.

5. The low performances obtained at variant V_1 is mainly due to the great number of passes of the agricultural units (at variant V_1, for preparing germination bed and sowing are made three passes of the units, while at variant V_3 is made only one single pass).

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