ESTABLISHMENT OF CONSERVATIVE TECHNOLOGIES OF TILLAGES MECHANIZATION ON WHEAT CROP FOR ROMANIA N-E AREA

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

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Abstract. *Concerning the establishment of conservative technologies of tillage mechanisation on wheat crop for Romania N-E area, in year 2007 autumn, six variants of technologie were experienced. We determined operation qualitative indices at each variant for each machinary, as well as, energetic and exploitation indices for each cultivator. After sowing of the crop, at certain time, it determined at each variant: soil resistance to penetration, pondered average diameter of the soil structural elements and the hydrical stability of these elements. It determined also, at each variant, the fuel consumption per hectare needed for the performing of the mechanised tillages for the wheat crop setting up. Having in view, the results obtained after experiments, we evaluated the variants of technologies for mechanisation of tillages according with the soil conservation conditions on wheat crop.*

Rezumat. *În vederea stabilirii tehnologiilor conservative de mecanizare a lucrărilor solului pentru zona de N-E a României, la cultura de grâu, în toamna anului 2007 s-au experimentat 6 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 însămânţarea culturii, la o anumită perioadă de timp, s-a determinat, tot la fiecare variantă, rezistenţa solului la penetrare, diametrul mediu ponderat al elementelor de structură ale solului şi stabilitatea hidrică a acestor elemente. De asemenea, la fiecare variantă s-a determinat consumul de combustibil la hectar pentru efectuarea mecanizată a lucrărilor necesare înfiinţării culturii de grâu. Pe baza rezultatelor obţinute în cadrul experimentărilor efectuate s-au evaluat variantele de tehnologii pentru mecanizarea lucrărilor corespunzător condiţiilor de conservare a solului, la cultura de grâu.*

GENERALITIES

Concerning the establishment of conservative technologies of tillage mechanisation on *wheat* crop for Romania N-E area, it experienced more variants of technologies. These technologies have been tested to establish which of them meet, in the highest level, the sustainable agriculture concept and which assure, first of all, protection, conserving and improvement of soil.

For this, each mechanization technology variant that includes conservative unconventionaly tillages made by adequated machinaries will be compared with sample variant where it is practiced conventionally tillage technology but the comparison is to be made also with other conservative technologies. Each variant of techology comprises primary tillage of soil, weed control, preparing of seed bed. Sometime, the tillages can be reduced and the sowing can be made directly in stuble (in unploughed soil). Because, several experimental technologies include complex unit that have in their structure sowing equipment, it established that the sowing is to be present to all technologies, in such way, these to be compared.

MATERIAL AND METHOD

Experiments regarding tilling mechanization technologies on wheat crop field were performing during 20 september 2007 till 3 april 2008. Experiments were made on cambic chernozem having a clay content of 36 percents and average values for apparent density and moinsture. The land average longitudinal slope has 2 grades. The sunflower was the previous plant.

Before tillage and sowing on wheat field, the SR 250 machine chopped all plant remains for all tillage mechanization technologies.

We experimented six variants of mechanization technologies of tillage and sowing. They are showed on *table 1*.

Variant V_1 is considered sample – variant, because, it represents a conventional technology (generally practiced on field).

We determined tillage quality indices for each technological variant and for each machinery (machinary or implement). We determined, also, energetic and exploitation indices for each technological variant and for each complex unit.

Table 1

Variants of tillage and sowing mechanization technology on wheat crop

Complex unit used	Variant of tehnologies
• tractor Valtra T-190 + reversible mouldboard plough Opal 140 • tractor U-650 + disc harrow GD-3,2 + tine harrow 2GCR-1,7 (3 types) • tractor U-650 + versatil sowing hauled SUP-29	V_1 (sample)
• tractor Valtra T-190 reversible mouldboard plough + Opal 140 • tractor Valtra T-190 + complex unit AGPS-24DR (harrow FRB-3 + sowing SPU-24DR), 540 rot/min at PTO	V_2
• tractor Valtra T-190 + heavy disc harrow GDG-4,2 • tractor Valtra T-190 + complex unit AGPS-24DR (harrow FRB-3 + sowing SPU-24DR), 540 rot/min at tractor PTO	V_3
• tractor U-650 + chisel PC-7 • tractor Valtra T-190 + complex unit AGPS-24DR (harrow FRB-3 + sowing SPU-24DR), 540 rot/min at tractor PTO	V_4
• tractor Valtra T-190 + loosening elements of soil fixed on complex unit AGPS-24DR (540 rot/min at tractor PTO)	V_5
• tractor Valtra T-190 + combined machine for soil processing and sowing on rows MCR-2,5 (sowed directly, on unploughed land), 1000 rot/min at tractor PTO	V_6

We determined after wheat sowing, for each variant: soil resistance to penetration, pondered average diameter of structural elements of soil and their hydric stability. Also, we determined at each variant, the fuel consumption per hectare for performing of soil mechanized tillage and sowing.

RESULTS AND DISCUSSIONS

After experiments, we obtained important results concerning: tilling qualitative indices, exploitation and energetic indices, soil resistance to penetration, indices related to stability of soil structural elements and total fuel consumption per hectare for the performing of soil mechanized tillage and sowing.

On table 2 are showed the main results obtained at experiments.

Table 2

Results obtained concerning the tillage quality, soil conservation and fuel consumption

Variant of technology	Quality indices for tillage preparation of seedbed		Indices concerning conservation of soil properties			Fuel consumption per hectare for the performing of soil mechanized tillage and sowing *l/ha*
	Breakage grade of soil *%*	loosening grade of soil *%*	Soil resistance to penetration *daN/cm²*	Pondered average diameter of soil structural elements *mm*	Hydric stability of soil structural elements *%*	
V_1 (sample)	70	29	1,35	4,86	78,6	33,670
V_2	90	26	2,65	4,45	77,9	25,800
V_3	92	25	4,50	3,52	74,4	16,350
V_4	93	24	1,45	3,63	75,7	16,870
V_5	95	22	3,25	3,79	76,4	11,160
V_6	100	20	7,50	4,28	78,0	7,697

Breakage grade of soil at preparation of seedbed has changed depending on the used technology from 70 % to 100 %.

Taking in view that, the agro-technical demands impose that the breakage grade of soil to tillage of seedbed to be minimum 90 %, then V_1 (sample) can not be applied (at this variant the breakage grade of soil does not meet, by far, limits stated by technical demands). The others variants have appropriate values for breakage grade of soil. Among these, V_6 is the best, breakage grade of soil being of 100 %.

Regard to **loosening grade of the soil,** the obtained values to the those six variants meet the limits established by agro-technical demands. If in case of breakage grade of soil, its value is increasing continuously from V_1 to variant $V_{6,}$ at loosening grade of soil, the situation is opposite: the more breakage grade of soil increases ,the more soil loosening grade reduces , which is normaly.

We have to mention that, the others tillage qualitative indices for the preparation of seedbed have not been presented because it considered that the most important qualitative index is breakage grade of soil**.** The problems that appear at the preparation of seedbed are because it can not assure a proper breaking of the soil. The reducing of the breaking grade of the soil having values under the limit stated by demands agritechnical appears on tillage of the seedbed for autumn crops.

Soil resistance to penetration has been measured second days after sowing moment when soil resistance to penetration was measured is important because during vegetation this one has a certain increasing.

We have to mention that, if previous plant is weeding one, the soil has a penetration resistance relatively reduced in certain depth, due to the weeding works. Within our test, the wheat followed after sunflower. We determined the soil penetration resistance, from 5 cm to 5 cm, untill a depth of 30 cm. On table, we show only the average value of this index in the depth of 10 cm because in this area, all machinary worked influencing the soil penetration resistance.

We determined also, soil resistance to penetration on an untilled soil, before performing the works for sowing of the wheat. In this case, in depth of 0 - 10 cm soil resistance to penetration was of 4,00 $daN/cm^{2.}$ Next day after wheat sowing, soil resistance to penetration in depth of 0 - 10 cm has changed depending on technology variant between 1,35 daN/cm^2 and 7,50 daN/cm^2. The smallest value of the index was registered at variant V_1 and the biggest at $V_{6.}$

Agro-technical demands stated several value classes of soil resistance to penetration: very small class = under 11 daN/cm^2; small class = 11 - 25 daN/cm^2; middle class = 26 - 50 daN/cm^2 etc. Comparing these demands with obtained results, we found that soil resistance to penetration is **very small** at all variants. So, soil resistance to penetrationis is very good for all variants.

We appreciate that soil resistance to penetration had such small values before tilling and sowing of crop. This explain that,the soil had a proper moinsture due to rains which overpassed monthly annual average, also, the soil had been frequently weeded on previous crop and we determinated the soil resistence to penetration even next day after sowing.

Agro-technical norms stated that for a soil resistance to penetration till 25 daN/cm^2, the plant roots grow normaly. Taking in view, agro-technical norms and obtained results we appreaciate that, there are conditions for a normal growing of wheat plant roots at all variants.

Pondered average diameter of soil structural elements was determined second days after sowing for three depth: 0 – 10 cm, 10 – 20 cm, and 20 – 30 cm. On table are presented the values of this index for a depth of 0 - 10 cm, area where all machinaries have operated.

Pondered average diameter of soil structural elements was determined also on untilled soil, before soil tillage. It found that on depth of 0 – 10 cm pondered average diameter of soil structural elements is in this case of 4,23 mm.

From table, it found that after sowing the pondered average diameter of soil structural elements varied between 3,52 mm, and 4,86 mm. The smallest value of this parameter has been registered at V_3 and the biggest one at V_1 variant. In case of variants, where mouldboard plough was not used the biggest value of this parameter has been registered at V_6 and the smallest one at V_3.

Agro-technical norms state that, from agronomical point of view, soil structural elements having diameter between 3 – 5 mm (even over 5 mm) are more important. Comparing these demands with obtained results, it found that pondered average diameter of soil structural elements is proper for all variants.

If it is compared the value of this index deternined on untilled soil (4,23 mm) with the values presented on table, it found that at V_6 (sowing direct) the value of index does not practically modified. At variants V_5, V_4, and V_3 the value of index diminshed due to active elements of machiries that have cut more or less soil strutural elements. At variants V_1, and V_2 the index has the biggest values because the mouldboard turned on the soil bringing to top the soil having a better structure (bigger element of structure).

Hydrical stability of soil structural elements was determined second days after sowing for three depth: 0 – 10 cm, 10 – 20 cm, and 20 – 30 cm. On table are presented the values of this index for a depth of 0 - 10 cm.

This index was determined also on untilled soil, before soil tillage. In this case it found that on depth of 0 – 10 cm hydrical stability of soil structural elements was of 77,3 %.

Agro-technical norms provide that if the hydrical stability of soil structural elements overpasses the limit of 60 %, this index sets in one class very high. Comparing the obtained results with agro-technical results. It can say that hydrical stability of soil structural elements is very good for all variants.

Analysing the obtained results, it finds that the smallest value of this index was recorded at V_3 variant, and the biggest one at V_1. At variants where the mouldboard plough was not used the biggest value of this index was recorded at $V_{6,}$ and the smallest one at V_3.

As regards, the comparison between value of this index at unploughed soil (77,3 %) and the values showed on table, all observations that were made at pondered average diameter of soil structural elements are available also in case of hydric stability.

Fuel consumption per hectare obtains by adding fuel quantities consumpted for mechanized tillage and sowing, namely the tillages provided at each variant of technology. We consider that the fuel consumption per hectare for mechanized tillage and sowing at each experimented variant is appropiate. The biggest consumption was recorded at $V_{1,}$ variant and the smallest one at V_6 variant.

Establishing of the technologies of mechanisation for soil tillage that will be applied. After the analyse of all determined indices at each variant, the researchers have stated the technology variants that will be applied, and their order.

If there are conditions for use of tillage conservation systems, we consider that the variants that can be applied beginning with the best one are: V_6, V_5, V_4, V_3. If V_6 variant can not be used, V_5 will be used. In case that V_5 can not be used, V_4 will be used. Finelly, if V_4 can not be used, V_3 will be used.

V_2 will be used, when it is imposed the use of moulboard plough. V_1 variant (sample) is not recommended to be applyed because the fuel consumption per hectare is too big, and the breakage grade of soil is unproper being situated under imposed minimal limit of agro-technical demands.

CONCLUSIONS

1. On the basis of the obtained results within experiments, researchers have stated the variants of technologies that are recommended to be applied.

2. When there are conditions of application of soil tillage conservative systems, variants that can be applied beginning with the best one are: V_6, V_5, V_4, V_3.

3. V_2 will be used when it is imposed the use of moulboard plough.

4. V_1 variant (sample) is not recommended to be applyed because the fuel consumption per hectare is too big, and the breakage grade of soil is unproper.

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