SOME RESEARCHES REGARDING THE USING OF PLOUGH-BODY WITH ANTE-MOULDBOARD IN THE PLOUGHS BUILDING

CERCETĂRI PRIVIND UTILIZAREA TRUPIȚEI CU ANTECORMANĂ ÎN CONSTRUCȚIA PLUGURILOR

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Abstract: *The plough body with ante-moldboard is a new tillage tool which assures an entire overturn of the furrow, a better incorporation in soil of the vegetable residues, a better disaggregating of the furrow, a diminution of the plough overall size relative to ploughs with ante-plough-body, and just a diminution of the power consumption especially in the case of the clay soils. In the framework of this paper are presented the experimental results regarding the comparative analysis of qualitative parameters of the plowing process for a normal plough with variable working width P-2V, and for a plough with ante-moldboard P-2VA, in the same working conditions.*

Rezumat: *Trupița cu antecormană este un nou organ de lucru pentru pluguri care asigură o răsturnare totală a brazdei, o mai bună încorporare în sol a resturilor vegetale, o mai bună mărunțire a brazdei, o micşorare a lungimii plugului în comparație cu plugurile prevăzute cu antetrupițe şi chiar o diminuare a consumului de combustibil în special în cazul solurilor argiloase. În cadrul lucrării sunt prezentate rezultatele experimentale privind analiza comparativă a indicilor calitativi ai procesului de arat pentru un plug cu trupițe clasice cu lățime de lucru variabilă P-2V şi ai unui plug cu trupițe cu antecormană P-2VA, pentru condiții de lucru similare.*

Key words**:** *moldboard, ante-moldboard, plough, qualitative parameters, plowing process*
Cuvinte cheie: *trupiță, antetrupiță, plug, indici calitativi, proces de arat*

INTODUCTION

The plough body with ante-moldboard is a Romanian concept of a new tillage tool for the ploughs, which assures a better incorporation of the vegetables residues in the soil, a better disaggregating of the furrow, and a better levelling of the ploughed surface due to the 180° angle of tilt of the furrow, no matter the depth of the working surface of the plough [1,4]. The ante–moldboard is mounted on the breast of the plough, in front of the so called moldboard replacing the breast of the digger plough and the additional plough as it can be seen in the picture above.

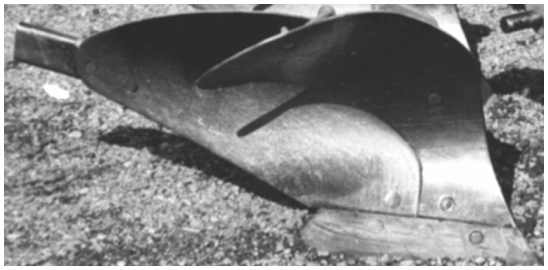


Figure 1. The plough-body with ante-moldboard

The active surface of the ante-moldboard has a conical shape. The line corresponding to the joint between the share and the moldboard is a generator to the cone of the active surface (Figure 2).

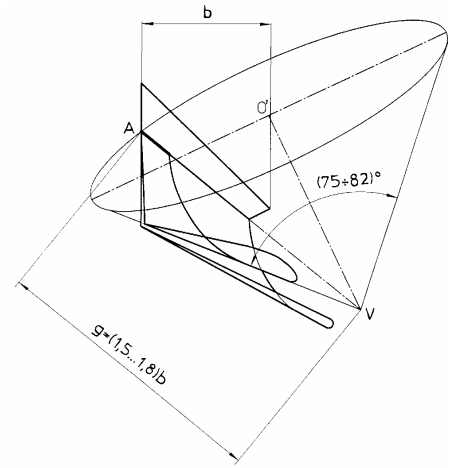


Figure 2. The active surface of the ante-moldboard

In the case of ante-moldboard tillage the disposal angle of the overturn furrow is 0^o, so the furrows are being turned with 180^o. The kinematics of the overturning in the case of ante-moldboard tillage is shown in figure 3.

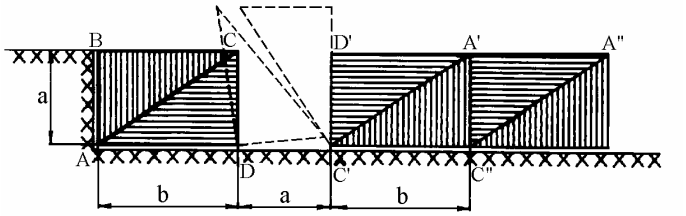


Figure 3. The kinematics of the overturn of the furrow in the ante-moldboard tillage process

The disaggregating ratio of the furrow can be considerable improved if the plough is fitted with ante plough body for each simple moldboard. The ante plough body is mounted at a 25-30 cm distance in front of the moldboard, on the frame of the plough, breaking in advance a smaller furrow ($a_1 \approx 1/3 \cdot a$ and $b_1 \approx 2/3 \cdot b$) which is disaggregated and tipped over in the ditch of the previous furrow, then is overlaid by the furrow broken and tipped over by the moldboard, accomplishing the complete incorporation of the surface fertilizers and vegetable residues into the soil.

The usage of the plough body with ante plough body has also a series of disadvantages such as: the blockage of the plough with vegetable residues that can catch at the ante plough body and especially the other disadvantage: the growth of the length and the overall size of the plough.

The tillage process can also be done with ploughs appointed with additional moldboard, in which case, under the action of the moldboard, the furrow is displaced on the surface of the moldboard until this one encounters the additional moldboard which is installed on the body of the plough, on its superior side and under its action a part of the superficial ply

of the soil is disrupted and shifted into the ditch of the previous furrow, improving in this case also, the disaggregating ratio of the furrow and the incorporation degree of the vegetable residues and fertilizers into the soil.

During the working process of the ante-moldboard plough, the furrow is subdued to a series of complex compression stress, to a bending process in a vertical and horizontal plane, and also to a twist in a transversal plane. Consequent upon al these stress the breakage and the crumbling of the furrow occurs during the disaggregating and overturning process. Disregarding the compression, it can be considered that the breakage of the furrow takes place when in the connection sections of the soil particles is being reached the unit stress breakage σ_r and $\tau_{r,}$ whose correspondents are the specific bending and torsion angles. It can be concluded that in the case of ante-moldboard plough, the spent energy during the working process is smaller with 15-20 % comparative with the simple moldboard plough.

MATERIALS AND METHOD

The comparative experimental tests for the determination of the qualitative index of the tillage for the two ploughs were carried out in the experimental ground of the I.N.M.A. Bucharest, on a plane field, during the September-October of the 1998. The parcel had been previously cultivated with corn, and covered with vegetable residues, specific to a corn cultivated land. The average vegetable residues on a 1 m² was 214,38 g/m², the result coming from the measurements carried out on the micro fields disposed on the diagonal of the experimental parcel.

The average humidity of the experimental soil allotment were at the value of 24,76%, resulting from the specific analysis of four samples of soil ploughed with the agrochemical bore. The apparent average density of the experimental soil allotment was of 1,317 g/cm^3, results from analysis of the samples taken from the arable soil, with the help of the metallic cylinders, at the volume of 200 cm^3.

To determine the working depth have been carried out measurements in 20 points displaced at a distance of 5 meters each, on a 100 m distance of the plough, performing three repetitions for each working depth established (20; 25; 30 cm). Two sets of measurements had also been done in identical conditions, for the assembly made of the tractor U-650 and the normal moldboard plough P-2V, respectively the ante-moldboard plough P-2VA. Both in the P-2V and P-2VA ploughs has been concluded that are kept the three conditions: the standard deviation of the working depth of at least $S_a < \pm 0,1 \cdot a_m$, the maximum deviation of the average working surface to be $\Delta_a < \pm 0,2 \cdot a_m$ and the variation coefficient of the working depth that must be at least $C_a < \pm 0,1$.

In order to determine the working breadth, measurements had been taken into 20 different points situated 5 meter each on a 100 meters distance reckoned by the tillage tool, reported to an aiming line displaced at a distance of 3 meters from the allotment, making three repetitions for a single unique established working breadth of 60 m. Two sets of measurements were done in identical conditions for the combiner created by the tractor U-650 and the normal moldboard plough P-2V, respective the ante-moldboard plough P-2VA. It has been also concluded that in the case of the P-2V plough and P-2VA is respected the following condition: the deviation of the standard working breadth of $S_B < \pm 0,1 \cdot B_m$, the maximum deviation from the average working breadth of $\Delta_B < \pm 0,2 \cdot B_m$ and the variation coefficient of the working breadth of $C_B < \pm 0,1$.

The degree of the soil desegregation has been established with comparative measurements on a number of five sample allotments, of 1 m^2 each, on the whole depth of the tillage done by the assembly compound from the tractor U-650 and the plough P-2V,

respective the plough P-2VA, by the means of weighing the processed soil and the grogs resulted. The used formula is the following:

$$M_{ms} = \frac{\sum_{i=1}^{n} \frac{m_{sci}}{m_{sti}}}{n} \cdot 100; \quad [\%] \tag{1}$$

in which: m_{sci} – is the weight of the boulder-rock with a diameter smaller then 5 cm, [kg]; m_{sti} – the total weight of the soil at a single measurement, [kg]; n – the number of the micro parcels, (n=5).

The degree of blanketing the soil with vegetables residues has been determined by comparative measurements on a number o five micro-parcels of 1m² each of the vegetable weight remained on the surface of the soil in the case of the tillage with the plough P-2V, respective the plough P-2VA. The used formula is:

$$G_{av} = \frac{\sum_{i=1}^{n} \frac{m_{vti} - m_{vai}}{m_{vti}}}{n} \cdot 100; \quad [\%] \tag{2}$$

In which: m_{vti} – represents the total weight of the vegetable residues initially encountered at the surface of the soil of a micro parcel, [kg], (Table 2); m_{vai} – the weight of the vegetable residues remained on the surface of the soil, [kg]; n – number of the micro parcels, (n=5).

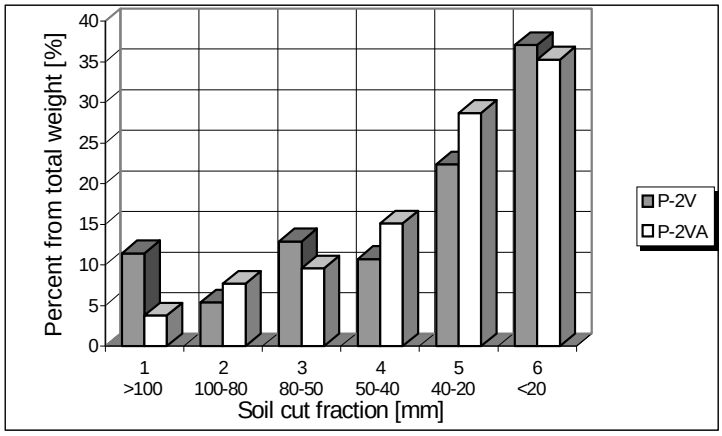
RESULTS AND DISCUSSION

In the table no 1 are shown the comparative data of the experimental measurements obtained as a result of the screening analysis with the determination device of the fractional components of the soil (type I.N.M.A. Bucharest) and the mathematic processing of the data, and in the figure no 4 are shown graphically and comparatively.

Table 1

The determination of the disaggregating degree of the soil

Assembly		Tractor U-650 + plough P-2V						Tractor U-650 + plough P-2VA					
Test		1	2	3	4	5	Av. Value	1	2	3	4	5	Av. Value
Total weight of sample[kg]		175,1	169,9	195,2	168,6	191,4	180,04	189,4	173,6	169,7	187,1	187,2	181,4
Weight of soil cut fraction [kg]	>100 mm	16	21,4	28,2	18,4	19,6	20,72	8	6,8	7,1	6,7	5,5	6,82
	100-80 mm	12,5	6,3	14,6	7,4	7,9	9,74	19,9	15,6	10,2	13,4	10,7	13,96
	80-50 mm	24	11,4	36,1	29,3	15,7	23,3	31,6	12,6	16,5	9,3	17,3	17,46
	50-40 mm	14,8	18,7	10,2	22,4	30,3	19,28	21	23,4	28,5	33,4	29,1	27,08
	40-20 mm	41,3	47,5	25,5	31,8	54,8	40,18	39,5	44,2	48	72,8	56,4	52,18
	< 20 mm	66,5	64,6	80,6	59,4	63,1	66,84	69,4	71	59,4	51,5	68,2	63,9
Percent from total weight [%]	> 100 mm	9,1	12,6	14,4	10,9	10,2	11,44	4,2	3,9	4,2	3,6	2,9	3,76
	100-80 mm	7,1	3,7	7,5	4,4	4,1	5,36	10,5	9	6	7,2	5,7	7,68
	80-50 mm	13,7	6,7	18,5	17,4	8,2	12,9	16,7	7,2	9,7	5	9,2	9,56
	50-40 mm	8,4	11	5,2	13,3	15,8	10,74	11,8	13,5	16,8	17,8	15,5	15,08
	40-20 mm	23,5	27,9	13,1	18,9	28,6	22,4	20,8	25,5	28,3	38,9	30,1	28,72
	< 20 mm	37,9	38	41,3	35,2	32,9	37,06	36,6	40,9	35	27,5	36,4	35,28
Weight of soil particles with ϕ < 50 mm, [kg]		122,6	130,8	116,3	113,6	148,2	126,3	129,9	138,6	135,9	157,7	153,7	143,16
Desegregation degree, [%]		70,01	76,98	59,57	67,37	77,42	70,15	68,58	79,83	80,08	84,28	82,10	78,91



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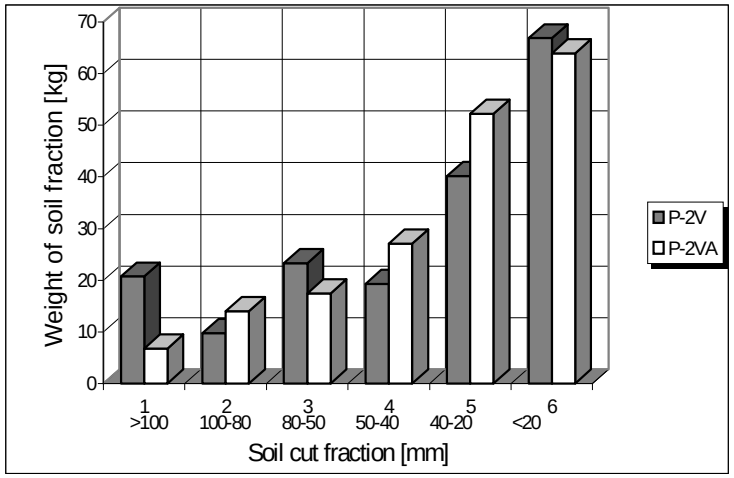

b)

Figure 4. The comparison of the disaggregating process with the plough P-2V and P-2VA

In the table no 2 is shown the comparative data of the experimental measurements obtained and processed mathematically, for the plough P-2V and P-2VA.

Table 2

The determination of the covering degree with vegetable residues

Assembly	Tractor U-650 + plough P-2V						Tractor U-650 + plough P-2VA					
Av. Weight of the vegetable residues, [g/m^2]	214,38						214,38					
Test	1	2	3	4	5	Av. Value	1	2	3	4	5	Av. Value
Weight of the vegetable residues on the surface of plowing field, [g/m^2]	17,6	15,2	20,3	17,1	21,8	18,4	4,3	5,1	4,7	6,5	5,2	5,16
Vegetable residues covering degree, [%]	91,79	92,90	90,53	92,02	89,83	91,41	97,99	97,62	97,80	96,96	97,57	97,59

CONCLUSIONS

-Our experimental assaying were carried out in almost optimum conditions, registering a slight humidity excess compared to the optimum, and all this was due to the excessively rainy season of the 1998. The optimum humidity of the clay appropriate for the tillage process is 17 %, reported to a clay content of 33% and an apparent density of the soil, on which the tests had been made, of 1,317 g/cm³, being also tolerable the values encompassed between 13-21 %. The developing conditions of the experiments were typical for the 1996-1998 and 2002-2005, when the season for the fall tillage work took place after a very rainy summer and excessively humidity.

- The normal moldboard plough accomplishes a disaggregating degree of the soil of 70,15 % (Table 1) and the ante-moldboard plough accomplishes a better disaggregating degree of 78,91 % (Table1);

- The normal moldboard plough accomplishes a vegetable residues covering degree of 91,41 % (Table 2) and the ante-moldboard plough a better covering degree of 97,59 % (Table 2);

-Comparing at large the qualitative index of the working process of the two ploughs, in identical conditions, can be concluded that the ante-moldboard plough P-2VA carries out a better tillage than the one of the simple moldboard plough, P-2V.

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