The 3rd International Conference on
"Computational Mechanics
and Virtual Engineering"
COMEC 2009
29 – 30 OCTOBER 2009, Brasov, Romania

NEW MECHANIZATION TECHNOLOGY FOR DECOMPACT AND AERATION IN-DEPTH OF IMPROPER SOILS, WHILE GIVING OF NUTRIENTS

Dr. ing. Iosif COJOCARU[1], Dr. ing. Nicolae CONSTANTIN[1], Dr. ing. Ion PIRNA[1], Dr. ing Eugen MARIN[1], Dr.ing. Alexandru COCIU[2]
[1]INMA Bucureşti, e-mail : icsit@inma.ro
[2]INCDA Fundulea, e-mail : office@incda-fundulea.ro

Abstract:. *New mechanization technology of soil working in arable substrate aims decompacting and aeration in depth of poor soils together with the administration of nutrients that can be applied on about 19.8% of total agricultural area of our country. Applying them to an appropriate quality level corresponding to agopedological requirements at as low cost and low power consumption required to promote a new technical equipment, with higher constructive and functional parameters, for wheeled tractors of 180-240 hp, equipped with five active organs such as reversible chisel knife and two rollers with claws, which is mounted an equipment to manage difficult soluble nutrients. New machinery called DECOM-FERTI, achieved a maximum depth of 40cm from the chiselation of ground and max. 60 cm at the working of soil from the arable substrate, working width being about 2.5 m and the working capacity of about 1.56 ha/h; administered nutrients with rates between 50 ...250 kg/ha.*
*Keywords****: machinery; decompacting and soil aeration, nutrient management.***

1. INTRODUCTION

Romania faces a degree of deterioration of soil quality through erosion phenomena, acidification, alkalizing, excess moisture or drought, salted, compaction, etc. The main process of soil degradation, by extension and socio-economic impact is the erosion by water, which with landslides include over 7 million ha of agricultural land. The second factor as importance in land degradation is periodical excess moisture which affect 3.8 million ha of agricultural land and 0.6 million ha of forest land and the frequent excess of drought is manifested on approx. 7.1 million hectares of farmland and 0.2 million hectares of forest. An important role in the physical degradation of soil is occupied by anthropogenic soil compaction and crust formation. Compaction is seen on about 1.3 million hectares of arable land and is mainly due to weight and or too frequent use of agricultural machinery, especially under conditions of inadequate soil moisture or on the soil too dry or on the soil too wet.
The new mechanization technology of the soil work in the arable substrate is specific to heavy soils and compact, alternately affected by humidity excess and deficiency and other types of soils that present limitations of production capacity due to salinisation, alkalinisation, pollution etc. Applying them to the appropriate quality level of the agropedological requirements at an as low as possible cost and low power consumption requires the provision of equipment with superior constructive and functional parameters.

2. TECHNICAL REQUIREMENTS

2.1. DESTINATION AND CONSTRUCTIVE DESCRIPTION

Machinery DECOM-FERTI (Figure 1), is the type worn by hydraulic lifting system of 180-240 hp tractors, category III, SR ISO 730-1 + C1: 2000 and is designed to run decompacting and aeration in depth of poor soils, while administration of nutrients and elimination of impermeable layer of soil (the hardpan) between the arable layer and substrate of it. It is use in autumn fall on degraded soils located on flat terrain or slope to 6^0.

Fig. 1. **DECOM-FERTI machinery**

DECOM-FERTI machinery consists of the following major assemblies: chassis, active reversible organs with chisel knives and special knives to remove the hardpan; working depth adjustment wheel; fertilizer equipment for heavy soluble nutrients.
Chassis ensure the equipment catching in three points to the thrusts of the tractor hydraulic lifting system and location of the **5 active organs** (each consisting of a base support that is mounted reversible knife type chisel, vertical knife and two knives type "L") for deep raising of arable soil substrate.
Rollers Claw provide shredding and a slight leveling of soil processed by active bodies, being placed behind them. They cling to the chassis through mediation of side walls and a deformable parallelogram and could adjust vertically at different distances from the active bodies.
Depth adjustment wheel ensures regulating and limiting of the depth of this active working bodies.
Equipment to manage nutrients is composed of the following main assemblies: the box with nutrient management system, tubes for administered nutrients, hydraulic installation, reducer, platform, ladder.

2.2. OPERATING

In early work, DECOM FERTE machinery is in transportation position. For the working position, it comes down slowly on the ground, is coupled hydraulic power transmission for the fertilization equipment then it is coupled the tractor gearbox in the desired working stage and starts to process the soil. The technical equipment is a farm machinery processing the soil with passive working bodies, nondriven from PTO. Active bodies penetrate the soil due to the attack angle and to the tensile strength achieved by driving tractor. The limitation of the depth is required by the position of roller claw (for working depths of up to 30 cm) and/or the position of roller claw and wheels for adjustment of the depth of work (for working depths of 30 ... 60 cm). Processed soil is displaced by the working bodies in the form of larger slices and are crushed by roller claw. Machinery is running concurrently with the mechanical work and with incorporation into soil of solid granular chemical fertilizers (ammonium nitrate, urea, nitrocalcar, superphosphate, complex, etc.). The movement at axes with distributors for fertilizers is transmitted through a reducer by a slow hydro-engine which is driven by the tractor hydraulic plant. Adjust speed axles with distributors and by default for fertilizer rates is made with a flow regulator valve (drosser). The distributors made on the principle of spira screw fitted with blades resulting from a propeller with four beginnings, take chemical fertilizers from bunker and distributes them through flexible tubes behind the working bodies.

2.3. Adjustments

- parallelism adjustment of framework with the ground surface in transverse plane is done by bringing the same length of vertical arms, adjustable tie support both side of the tractor hydraulic elevator;
- parallelism adjustment of framework with the surface in longitudinal field is made by lengthening or shortening the rods of the central hydraulic elevator of the tractor;
- depth adjustment is done by setting metal wheel support in a proper position to desired working depth correlated with position of roller claws;
- adjusting the rates of nutrient administration is made continuously, with a reducer and a hydromotor.

2.4. CONSTRUCTION AND FUNCTIONAL CHARACTERISTICS

2.4.1. Constructive characteristics

- Type	tracted
- Tractor required, CP	180…240
- Working width, m	2,5
- Nr.raising bodies	5
- Distance between raising bodies, mm	510
- Type of raising bodies :	- cutit dalta reversibila - « L » left - right - vertical knife
- Nr. of smoothing roller-crushers	2
- Diameter of roller leveling-shredding, mm	500
- Capacity of fertilizer boxes, dm^3	300
- Administered nutrients: solid chemical fertilizer, superphosphate, complex, ammonium nitrate, urea, nitrocalcar etc.	
- Overall dimensions, mm	
- Length	1765
- Width	2400
- Height	
- in work	1865
- in transportation	2165

2.4.2. Functional Characteristics

- Working depth, cm:	
- raising deep	max 60
- chiselling	max 40
- Speed in transport, km/h	4…8
- Nutrient management rules, kg/ha	50…250
- Rules for the administration of phosphorus and potassium, kg/ha	70…120

2.5. TESTING IN FIELD-LABORATORY CONDITIONS AND OPERATING

House tests and field-laboratory conditions DECOM-FERTI of technical equipment were made in the establishment SC MAT SA Craiova and the land of the Agricultural Society CRINA Bărcăneşti, Jud. Olt in the aggregate with 195 hp tractor factory ZIMBRU SC MAT SA Craiova. Figure 2 is presented technical equipment DECOM-FERTI (left). DECOM technical equipment (right) in aggregate tractor ZIMBRU.

Determining the extent of raising the soil

The main quality indicator of work at the work of arable soil in substrate is **the degree of raising of soil**. The degree of raising of soil was determined by measuring the coordinates of various points from a reference system (Fig. 3), consisting of a ruler above the field over two pales. Ruler was placed horizontally by mean of an air bubble level and was oriented perpendicular to the direction of advance of the machine.

Fig. 2. Machinery DECOM-FERTI and Technical Equipment DECOM in aggregate with tractor ZIMBRU

There were measurements of distances between ruler and field, at distances of 10 to 10 cm and 2 profiles were performed for each repetition.

The degree of raising of soil was calculated in%, with the relation:

$$G_{as=} \frac{\sum_{i=1}^{i=n} \frac{h_1 - h_2}{h_1}}{n}.100$$

Fig. 3. Appearance during h1 ordinate determination

in which:

h_1 = size measured in a specific point from the ruler to the soil surface, before passing the machine;

h_2 = size measured at the same point from the ruller to soil surface after passing of the machine;

n = number of measurements taken.

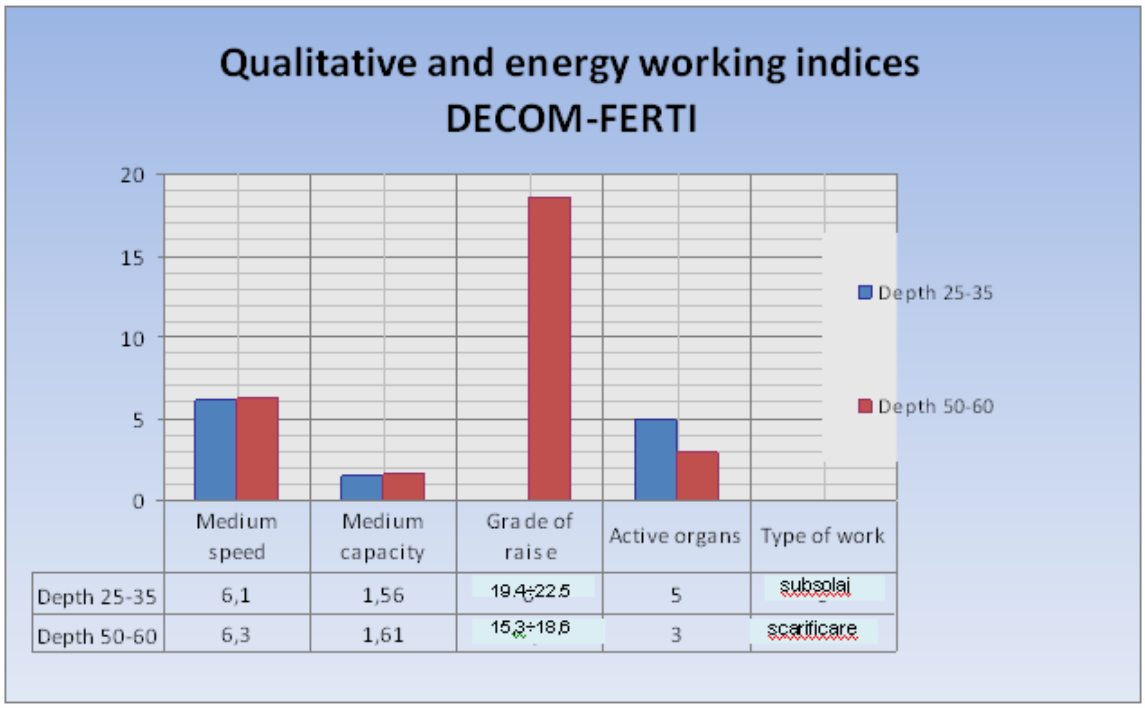

Fig. 4. Variation of work index of technical equipment DECOM-FRETI

When tested in the period August-September 2009, DECOM-FERTI machinery has made quality works, working with corresponding qualitative indicators and energy, within the limits of agro-index requirements shown in the diagram in Figure 4:

Equipment has a good stability in horizontal and vertical plane.
The main qualitative indices of work and energy are:

- grade of raise, %	G_{as}=19,4÷22,5% la 25÷30 cm
	G_{as}=15,3÷18,6% la 50÷60 cm
- working depth, cm	50-60 la scarificarea solului
	25-35 la subsolajul solului
-m, km/h	6,3 la scarificarea solului cu trei organe active
	6,1 la subsolajul solului cu cinci organe active
-medium capacity of work, ha/h:	1,61 la scarificarea solului cu trei organe active
	1,56 la subsolajul solului cu cinci organe active
-medium fuel consumprion, l/ha	23,00 la scarificarea solului cu trei organe active
	22,50 la subsolajul solului cu cinci organe active
- rate for administration of nutrients, kg/ha	50÷250
- factor of safety in exploitation	0,99
- hourly working capacity for performance, ha/h	1,74

3. CONCLUSIONS

Following tests it have resulted following advantages of the use of technical equipment DECOM-fertile, for tractors of 180 hp -240:
- can work in all types of soil at optimum moisture or low soil to produce a maximum degree of raising its
- may conduct soil work (scarificarea the horizon B1) in arable substrate equipped with three active bodies work and the distance between them at 100 cm soil subsolajul (raising the horizon A2) equipped with five active organs work and the distance between them in 51 cm
- administered nutrients between 50kg/ha minimum norm and maximum norm of 250 kg/ha
- easily penetrate the soil to the depth of maximum aggregate space map in the meantime is about. 0.50 m
- has good stability in a working position, both vertically and horizontally across the entire range of working depths achieved
- ensure proper raising of the soil, without return, reversal or mixing of soil horizons

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