TECHNICAL EQUIPMENT OF HIGH PRODUCTIVITY TO PREPARE SUMMER-AUTUMN CROPS SEEDBED AND STUBBLE-CLEANING

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Abstract: *Currently, germinating bed soil works, in summer-autumn, on plugging fields is executed, mostly, with light or medium-sized disc harrows in combination with tractors of 65 HP, with specialized combines or heavy harrows from abroad, working with high power tractors. To prepare the germinating bed with light or medium-sized disc harrows means big quantity of fuel consumption, increasing period of agricultural works, low productivity and an inadequate germinating bed soil in condition of low soil humidity. In order to integral mechanization of preparing germinating bed soil it is necessary utilization of new aggregates, of big productivity, able to execute very good quality works , the goal being to decrease specific energy consumption, the mass of machinery and number of crossing to avoid soil compaction. In these circumstances, it is necessary to design and promote a harrow with independent discs and shredding rollers(clod crusher), that works in combination with high-power tractors, designed to help at stubble-cleaning works and preparing germinating bed soil on recently ploughing fields where summer-autumn crops are set. Researches that were effectuated last years are on the line of sustainable agriculture systems, having established as primary objective, the promotion of agricultural tillage equipment that have as effect to grow the productivity, to execute optimal tillage works, to contribute to obtaining big quantity and the best quality of agricultural production, with low fuel consumption and low cost price. Taking into account that fields set with summer-autumn crops means a significant percent of country area (40%), recently, the soil works are executed by harrows in combination with high-powered tractors, according with the benefits they confer(good productivity and low fuel consumption). The new technology includes soil works of stubble-cleaning and germinating bed preparing on recently plugging fields or on non ploughing fields where summer-autumn crops are set; it could be apply to a quality level corresponding to agriculture requirements at a low cost price and with low power consumption, by promoting a new technical equipment „independent disc harrow", GD-4, working with wheeled tractors of 120-220 HP. The independent disc harrow GD-4, performs working depths of 6-8 cm during stubble-cleaning works and of 10-14 cm during germinating bed soil preparing, on the recently ploughing fields or on the non ploughing fields, working width being of about 4 m and working capacity of 2.9 -3.0 ha/h.*

Key word: ***tillage equipment, disc harrows, soil preparing***

INTRODUCTION

Currently, germinating bed soil works, in summer-autumn, on plugging fields is executed, mostly, with light or medium-sized disc harrows in combination with tractors of 65 HP, with specialized combines or heavy harrows from abroad, working with high power tractors.

To prepare the germinating bed with light or medium-sized disc harrows means big quantity of fuel consumption, increasing period of agricultural works, low productivity and an inadequate germinating bed soil in condition of low soil humidity.

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Tillage soil works executed using the disc harrows have good quality and makes a good shredding, mixing and mobilization of soil in conditions of low humidity.

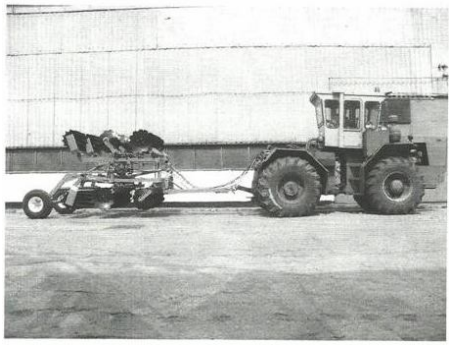
The independent disc harrows has two big advantage: easy crossing over obstacles that might appear in process work and spherical disks that have a low degree of wear, because, in process work requests (stresses) are distributed uniformly along the all length of edge.

MATERIALS AND METHODS

Using area: independent disc harrow, GD-4 is designed to plough soil in order to prepare germinating bed soil, necessary to sow (seed); this harrow executes many functions, as shredding clods, raising soil, destruction of plant debris. During the stubble-cleaning works the harrow executes raising soil surface, cutting weeds and

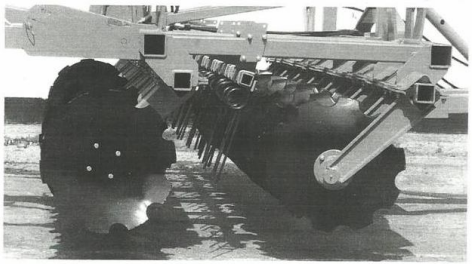
On the fields without debris in excess and with adequate soil humidity, the harrow can prepare germinating bed in order to be sowed, by two crossings over, with a working depth of 10-14 cm.

Disc harrow is used in summer-autumn and sometimes in spring on all types of soil, flat fields or up to 6^{o}.



Independent disc harrow GD4

Rollers of independent disc harrow GD-4



Disc battery of independent disc harrow GD-4 (side image)

Constructive and functional description: independent disc harrow works in combination with tractors of 120-220CP, equipped with drawbar and three-point suspension mechanism, category III SR ISO 730 -1 + C1: 2000.

Independent disc harrow, GD-4, is composed from the following:

- **Chassis - consists** of central bar and two sidewise frames that can be vertically removable for transport position. On the central bar it is put the triangle of couple, traction beam, two central discs semi-batteries, the central roller and rail transport.
- **Disc battery** (front and back), has a central semi-battery and two side-wise semi-batteries that can be put in vertically position during transport position.
  Each semi battery consists of spherical disks, corrugated (eight pieces for each battery and four pieces for side-wise semi batteries), oscillating ball bearing, fastening axle, and disk support brackets; all of these are mounted on a square pipe, using flanges and rubber bars.
- **Train transport** is designed to help harrow to travel on public roads and it is composed from one welded frame and two wheels tires
- **Shredding and leveling rollers** are put behind the disc batteries and ensure easy grinding and smoothing of processed soil. For transport position the rollers can be vertically adjusted, assuring limit gauge transport of 3 m required by legislation.
- **Hydraulic installation** has function to set the harrow in transport position from the work position and vice versa; it is composed of two hydraulic cylinders, hydraulic couplings and coupling valves.

Technical and functional features:

Technical features	*Function features*
• Tractor 120-220 HP • Working Width [m] : maximum 4 • Limit gauge transport width [m] : 3 • Number of discs batteries [peaces] : 2 • Number of spherical discs [peaces] : 32 • Diameter of discs [mm] : 610 • Distance between disks [mm] : 250 • Number of shredding mechanisms [peaces] : 3	• Working depth [cm] : 10-14 • Transport speed [km/h] : 10 • Working speed [km/h] : maxim 8

EXPERIMENT RESULTS

Test method

The experimental test was made in combination with tractor T195, the goal being to determinate functional features of discs harrow and main quality and energetic indices of work that was done.

To test this harrow, it was used only legal measure devices checked by Metrological Institute

Test conditions:

- Soil type: cambic chernozem
- Previous crop: corn, wheat
- plant debris height: 8-15 cm
- plant debris mass: 180 g / cm2
- Soil humidity:
  layer of 0-10 cm: 12.2%
  layer of 10-20 cm: 14.9%
  layer of 20-30 cm: 15.7%

Experiment was done in July-September 2009, according currently legislation:

- Special procedure PSPI-01.10.29 "Test of discs harrows"
- Special testing procedure PSPI-01.00.33 "Determination of energetic indices of agricultural aggregates"

During this test, it was checked the good functionality of the harrow and it was executed necessary adjustments to assure the vertically and horizontally stability of the harrow. The main **quality indices** resulted from the test are:

Quality indices	**Stubble-field**	**Clods Ploughing**	**Normal ploughing**
Average working depth α_m [cm]	10.1	12.3	14.2
Average working width B_m [cm]	396	399	402
Levelling soil degree G_{ns} [%]	43.6	45.4	46.2
Shredding soil degree G_{ms} [%]	75.1	77.6	80.2
Coverage of plant debris degree G_v [%]	95.2	95.9	96.6
Raising (loose soil) degree G_{as} [%]	20.1	23.5	26.2

Main **energetic indices** are:

Parameters	**Effectiv working speed [km/h] Patinarea [%]**			**Effective working capacity [ha/h]**			**Fuel consumption [l/ha]**		
	III R	**IV R**	**VR**	**IIIR**	**IVR**	**VR**	**IIIR**	**IVR**	**VR**
Normal plowing	4.51 10.0	6.75 15.7	8.14 18.6	1.96	2.70	2.63	9.53	8.49	7.82
Clods ploughing	4.61 7.8	6.88 14.0	8.58 17.2	1.84	2.75	2.88	8.51	8.11	7.45
Stubble fields	4.66 6.8	7.2 10.00	8.8 15.9	1.86	2.88	2.82	7.54	7.32	7.23

Working time structure. The value of effective working time of a shift is one of the most important factors that affects the working capacity of harrow. Values of working time are presented in the fallowing table:

Symbole	**Description**	**Value (minimum)**
T_1	Effective working time	418
T_{02}	Operating time	430
T_{04}	Production time	442
T_{07}	Shift time	477
T_{08}	Total working time	480
T	Performance time	477

The values of working capacities of the aggregate obtained during the test are the fallowing:

Symbole	Description	Formula	Value
W_{ef}	Working capacity in an hour of effective time	$K_{ef} = 60\ U / T_1$	2.75
W_{02}	Working capacity in an hour of operating time	$K_{02} = 60\ U / T_{02}$	2.67
W_{04}	Working capacity in an hour of production time	$K_{04} = 60\ U / T_{04}$	2.60
W_{07}	Working capacity in an hour of shift time	$K_{04} = 60\ U / T_{07}$	2.41
W_p	Hourly working capacity of performance	$K_p = 60\ U / T$	2.41

CONCLUSIONS

Analyzing results of test experiment, we can say about independent disc harrow, GD-4, the fallowing:

- It works with range of wheeled tractors of 120-220 HP having a good productivity and a lower fuel consumption
- It executes stubble cleaning and preparing germinating bed soil works in order to seed cereals and wide row crops; it is used on all kind of soils, flat fields or up to 6^o
- It has obtained good quality works, with a high level of shredding soil and of elimination of plant debris; it has obtained very good quality and energetic indices
- It has advantage to easily cross over obstacles appeared in working process
- It is reduced the soil compaction decreasing number of crossing and work operations
- Regarding construction, it consists of two corrugated disks batteries and added shredding mechanisms (rollers) ; it has an working width of 4 m.
- Regarding functionality , it is easy to handle, maintain and exploited during working process, safety indices being minimum 0.95
- it is safety during the transport and respects the traveling legislation on public roads
- Technical and technological safety have registered high values , it was not necessary to have waste time (to repair)
- The experiment results, obtained with agriculture aggregate, are in according with national and international currently legislation, technical equipment of experiment have being adequate of INMA Bucharest possibilities.

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