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Estimating the Energy Requirements and some of Technical properties for someof seed bed Preparation Equipment.

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Abstract:
BACKGROUND: *The presence of farm tractor, and his active rule to operates most of farm equipment in the second half of the nineteenth century made it the main source of power in the farm, many developments on tractors had led to the improvement and variation of their power sources. The multiplicity and diversity of soil types, crops, agricultural process and climatic conditions due to different countries or regions led to found different collections of seed bed preparation equipment each one has different function.*
OBJECTIVE: *To estimating and evaluating the energy requirements and some technical indicators of some seed bed preparation equipment with New Holland tractor.*
RESULTS: *Land plane showed a superiority comparing with disc ridger and ditcher in recording higher practical productivity, lowest fuel consumption, lowestmachinery unitenergy requirement, and the lowest treatment practical depth.*
CONCLUSION: *Land plane with rotary harrow and the chiselplow achieved the highest practical productivity, lowest treatment practical depth, and the lowest energy requirement. While the ditcher with spring spike tooth harrow and disk plow achieved the lowestpractical productivity, the highest treatment practical depth. in addition, the ditcher with disc harrow and disc plow achieved the highest fuel consumption and the highest energy requirement.*
Keywords: *Practical Productivity, Fuel Consumption, Energy Requirements, Treatment Practical Depth.*

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I. Introduction

Using of agricultural mechanization in the various agricultural operations led to improve the agricultural production in quantity and quality also to increase the area cultivated with different crops. The presence of agricultural tractor, and his active rule to operatesmost of farm equipment in the second half of the nineteenth century and precisely in 1850 made it the main source of power in the farm, many developments on tractors have led to the improvement and variation of their power sources [1]. The multiplicity and diversity of soil types, crops and climatic conditions due to different countries or regions ledto found different collections of soil preparation equipment and tools [10],for example, primary tillage equipment or primary soil preparation equipment like theplows, and all types of harrowing equipment, also the equipment that's used for special soil preparation treatments like the ditcher which is used mainly toexcavating the irrigation canals, disk ridger with its two typesto collect the soil while passing through the field in order to separate the different types of the crops from each other, and the land plane that used to give the soil surface an appropriate slope as well asall of the machinery that depend on farm tractor in their work [3,10].

Al – Hashimy et al. [6] found a significant effect to the equipment type on the fuel consumption and energy requirement, he stated that ditcher recorded a higher value to the fuel consumption and energy requirement comparing with land plane and disc ridger.

The practicalproductivity of the machine especiallyfor soil preparation equipment can be defined as the amount of area that the machine or equipment can deal with during a unit of time. The practicalproductivity is effected by several factors like the practical width of the equipment and the speed of the machinery unit.

The amount of fuel consumed per unit are dependon different factors, like the horsepower of the machine engine, type of fuel, type of treatment and the treatmentdepth,soil texture, age and engine condition plus the time needed to complete the operation, as well as the type of machine or equipment used with the tractor [20]. There are many factors affect the amount of fuel consumption during the field operations such as: -

type and condition of the surface of the soil, relative humidity, climate conditions, tractor type, engine horsepower, and the relationship between tractor and the equipment [18].

The amount of energy spent by any machine or equipment during any agricultural operation is one of the most important indicators to evaluate the performance of this machine. The energy requirements of any machine are affected by several factors: soil type, soil moisture, soil density, operation type, crop type, operation velocity, depth and type of treatment [17, 5].

To estimating and evaluating the energy requirements as well as some technical indicators for some of soil preparation equipment with New Holland tractor, we proposed this study.

II. Materials and Methods

The experiment was conducted on a farm belong to the college of Agriculture / University ofBaghdad at Abu-Gharib during 2012 in Silty clay loam Soil. New Holland tractor (TD-80) with different types of tillage equipment were used in this study, soil texture and some of the soil chemical and physical characteristics is shown in Table (1).

Table (1) Some chemical and physical properties of the soil used in the experiment

PH	**Ec Ds/m**	**Soil Humidity %**	**Total Porosity %**	**Bulk Density Mg/m³**	**Soil Texture**	**Soil Separators Gm/Kg**		
						Silt	Clay	Sand
7.52	8.69	15.28	41.35	1.56	S.C.L	317	581	102

The total field area for the experiment was 0.54 ha, with a length of 100 m and a width of 54 m. The field was divided depending to the experimental design used in the experiment. The randomize completely block design (RCBD) with split – split plot arrangement was used as the experimental design in this studywith three replications[8]. Three factors were used: first factor was the primary tillage equipment which consist of mold board plow, disc plow, and chisel plow, these represent the main plots. Second factor was the secondary tillage equipment which consist of the rotary harrow, spring spike tooth harrow, and disc harrow, these represent split- plot. Third factor was the special soil preparation equipment which consist of disc ridge, ditcher and land plane these represented split-split plots. The New Holland tractor (TD 80) was used in this experiment, made in Turkey had four engine cylinders, and the engine horse power was75 hp.

The following indicators were studied:

1. Practical Productivity (ha / hour):

The practical productivity was determined by using the following equation: [12]

$$P.pr. = 0.1 \times V_P \times W_P \times F_E \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 1$$

P.pr. = Practical productivity (ha / hour

V_P = Practical velocity (Km / hour)

W_P= practicalwidth (m).

F_c = field capacity (%), in this experiment the field capacity was used equal to (80%). [16]

2. Fuel Consumption (L / ha):

To measure the amount of fuel consumed per unit area, the following equation was used: [7]

$$Fu.c = Qd*10000 / Wp * D * 1000 \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 2$$

Fu.c = the amount of fuel consumed per unit area (L / ha).

Qd = the amount of fuel consumed per treatment (ml).

D = the replicant distance (m).

The results of fuel consumption (L / ha) represent the amount of fuel consumed during practical fieldwork only [4, 14].

3. Energy Requirement (Kw.hour / ha):

This represent the amount of power spent by the machine engine to complete any operation multiplied by the time it takes to complete this process divided by the unit area. The power requirements of any machinery are influenced by several factors: soil type, soil moisture, soil density, previous mechanical processes, crop type, process speed, depth and type of treatment, as well as type of equipment [5, 8, 17].

The engine power and power requirements of the mechanic unit were calculated by using the following formula: [13]

ER= E.P /P.pr.………………………………3

EP = Engine power (Kw).
ER = Energy requirement (Kw.hour / ha).

4. Treatment practical depth (Cm):
This refer to the maximum depth reached by the working part of the machine in the field.

III. Results and Discussion

3.1 Practical Productivity (ha / hour):

Table (2) shows the effect of the equipmenttype in the practical productivity of the machinery unit (ha / hour). The table shows that land plane recorded a higher average practical productivity of (1.401 ha / hour), while both the disk ridger and the ditcher recorded a practical productivity equal to (0.714, 0.650 ha / hour)respectively, and the reason for that is that the land plane has the larger practical width comparing with the other equipment and thus it will have the larger practical productivity.

The table also shows the superiority of the chisel plow in recording the highest practical production (0.939 ha / hour) while the disk plow recorded a practical productivity equal to (0.907 ha / hour).

It is also noted from the table that the rotary harrow recorded a higher practical productivity (0.936 ha / hour), while both the disk and spring spike tooth harrows were recorded a practical productivity equal to (0.923, 0.906 ha / hour) respectively.

Result in table (2) indicated that land plane with chisel plow recorded a higher practical productivity (1.422 ha / hour), while ditcher with disc plow recorded a lower practical productivity (0.641 ha/ hour). Also the results showed that land plane with rotary harrow recorded a higher practical productivity (1.418 ha / hour), while ditcher with Spring spike tooth harrow recorded a lower practical productivity (0.637 ha / hour).

It is also can be noticed from the table the significance of the triple interference between (primary, secondary and special tillage equipment) on the practical productivity of the machinery unit. The highest productivity was (1.437 ha / hour) was recorded by the tillage system (land plane with rotary harrow and chisel plow), while the tillage system consists of (ditcher with spring spike tooth harrow and disc plow showed the lowest actual productivity (0.627 ha / hour).

Table (2). Effect of equipment type on the practical productivity of machinery unit (ha / hour).

Primary equipment	Secondary equipment	Special equipment			Interference between primary and secondary equipment
		Disc Ridger	Ditcher	Land plane	
Disc Plow	Rotary Harrow	0.710	0.657	1.407	0.924
	Spring spike tooth harrow	0.680	0.627	1.357	0.888
	Disc harrow	0.693	0.640	1.390	0.908
Sweep Plow	Rotary Harrow	0.727	0.663	1.410	0.933
	Spring spike tooth harrow	0.697	0.633	1.380	0.903
	Disc harrow	0.747	0.650	1.403	0.921
Chisel Plow	Rotary Harrow	0.723	0.670	1.437	0.951
	Spring spike tooth harrow	0.737	0.650	1.410	0.928
	Disc harrow	0.712	0.660	1.420	0.939
Least significant differences 5%		0.043			0.345
Special equipment Average		0.714	0.650	1.401	
Least significant differences 5%		0.014			
Primary equipment					
Disc Plow		0.694	0.641	1.384	0.907
Sweep Plow		0.711	0.649	1.398	0.919
Chisel Plow		0.736	0.660	1.422	0.939
Least significant differences 5%		0.025			0.014
Secondary equipment					
Rotary Harrow		0.728	0.663	1.418	0.936
Spring spike tooth harrow		0.700	0.637	1.382	0.906
Disc harrow		0.713	0.650	1.404	0.923
Least significant differences 5%		0.026			0.014

3.2 Fuel Consumption (L / ha):
Table (3) shows the effect of the equipmenttype in the Fuel Consumption of the machinery unit (L / ha).The table shows that land plane recorded a lowest average fuel consumption (17.947 L / ha), while both the disk ridger and the ditcher recorded a fuel consumption equal to (33.927,37.147 ha / hour) respectively, and the

reason for that fuel consumption usually affected by the equipment practical width and the equipment adjustment depth, the increase in the equipment practical width will decrease the machinery unit fuel consumption, while the increase in the equipment adjustment depth will increase the fuel consumption (L / ha). [5]

The table also shows the superiority of the chisel plow in recording the lowest fuel consumption (25.473 L / ha) while the sweep plow and disk plow recorded a fuel consumption equal to (29.779, 33.769 L / ha) Respectively.

The table also shows the superiority of the spring spike tooth harrow in recording the lowest fuel consumption (28.006 L / ha), while the rotary and disk harrow recorded a consumed fuel per area (29.660, 31.355 L / ha) respectively.

Result in table (3) indicated that land plane with chisel plow recorded a lowest fuel consumption (15.163 L / ha), while ditcher with disc plow recorded the highest fuel consumption (41.204 L / ha). Also,the results showed that land plane with Spring spike tooth harrowrecorded a lowest fuel consumption (16.692 L / ha), while ditcher with disk harrow recorded the highest fuel consumption (38.452 L / ha).

It is also can be noticed from the table the significance of the triple interference between (primary, secondary and special tillage equipment) on the machinery unit fuel consumption. The lowest amount of fuel consumption (14.021 L / ha) was recorded from the tillage system (land plane with rotary harrow and chisel plow), while the tillage system consists of (ditcher with disc harrow and disc plow) showed the highest fuel consumption (42.363 L / ha).

Table (3). Effect of equipment type on the fuel consumption of machinery unit (L / ha).

Primary Equipment	Secondary equipment	Special equipment			Interference between primary and secondary equipment
		Disc Ridger	Ditcher	Land plane	
Disc Plow	Rotary Harrow	38.637	41.670	21.210	33.839
	Spring spike tooth harrow	37.120	39.580	20.071	32.259
	Disc harrow	40.910	42.363	22.350	35.208
Sweep Plow	Rotary Harrow	34.847	36.517	17.807	29.723
	Spring spike tooth harrow	32.747	35.307	15.973	28.009
	Disc harrow	37.877	38.327	18.613	31.606
Chisel Plow	Rotary Harrow	27.050	33.667	15.533	25.417
	Spring spike tooth harrow	25.000	32.223	14.027	23.750
	Disc harrow	31.157	34.667	15.930	27.251
Least significant differences 5%		8.912			9.643
Special equipment Average		33.927	37.147	17.947	
Least significant differences 5%		3.376			
Primary equipment					
Disc Plow		38.889	41.204	21.212	33.769
Sweep Plow		35.157	36.717	17.464	29.779
Chisel Plow		27.736	33.519	15.163	25.476
Least significant differences 5%		4.660			3.376
Secondary equipment					
Rotary Harrow		33.511	37.284	18.183	29.660
Spring spike tooth harrow		31.622	35.703	16.692	28.006
Disc harrow		36.648	38.452	18.964	31.355
Least significant differences 5%		5.687			3.376

3.3 Energy Requirement (Kw. hour / ha):

Table 4 shows the effect of the equipment type on the energy requirements of the machinery unit (Kw. hour / ha). It is clear from the table that the land planerecorded the minimum energy requirement for the machinery unit (72.528 Kw. hour / ha), while disc ridger and ditcher recorded an energy requirements equal to (128.232, 148.544 Kw. hour / ha) respectively. The reason for that is there is a significant relation between energy requirements of the machinery unit with the amount of fuel consumed, the greater the amount of fuel consumed per unit area the greater the energy required for a machinery unit and vice versa.

The table also shows the superiority of the tillage system using the chisel plow in recording the minimum energy requirement for the unit area (97.945 Kw. hour / ha). While,the rest of the systems, including the sweep plow and disk plow, recorded energy requirement equal to(116.920, 134.439 Kw. hour / ha) respectively.

Also, the table shows that the spring spike tooth harrow recorded the lowest average energy requirements for the unit area (112.411 Kw. hour / ha), while the rotary and disc harrow recorded an average energy requirements equal to (114.131,122.143Kw. hour / ha) respectively.

Result in table (4) indicated that land plane with chisel plow recorded a lowestenergy requirements (60.076Kw. hour / ha), while ditcher with disc plow recorded a highestenergy requirements (165.547Kw. hour / ha). Also, the results showed that land plane with Spring spike tooth harrow recorded alowerenergy requirements (68.870Kw. hour / ha), while ditcher with disk harrow recorded a higher energy requirements (153.240Kw. hour / ha).

It is also can be noticed from the table the significance of the triple interference between (primary, secondary and special tillage equipment) on the machinery unit energy requirement.The lowest amount of energy requirement (55.890 Kw. hour / ha) was recorded from the tillage system (land plane with spring spike tooth harrow and chisel plow), while the tillage system consists of (ditcher with disc harrow and disc plow) showed the highest energy requirement (171.020 Kw. hour / ha).

Table (4). Effect of equipment type on the energy requirement of machinery unit ((Kw. hour / ha).

Primary Equipment	Secondary equipment	Special equipment			Interference between primary and secondary equipment
		Disc Ridger	Ditcher	Land plane	
Disc Plow	Rotary Harrow	147.730	162.780	85.400	131.970
	Spring spike tooth harrow	146.500	162.840	83.860	131.070
	Disc harrow	159.390	171.020	90.430	140.280
Sweep Plow	Rotary Harrow	127.520	147.060	71.140	115.240
	Spring spike tooth harrow	125.150	149.900	66.870	113.980
	Disc harrow	137.310	152.510	74.820	121.540
Chisel Plow	Rotary Harrow	101.240	128.250	61.460	96.980
	Spring spike tooth harrow	94.500	126.350	55.890	92.250
	Disc harrow	114.740	136.190	62.880	104.600
Least significant differences 5%		36.703			37.468
Special equipment Average		128.232	148.544	72.528	
Least significant differences 5%		13.759			
Primary equipment					
Disc Plow		151.207	165.547	86.564	134.439
Sweep Plow		129.994	149.821	70.944	116.920
Chisel Plow		103.496	130.264	60.076	97.945
Least significant differences 5%		18.762			13.759
Secondary equipment					
Rotary Harrow		125.500	146.030	72.670	114.731
Spring spike tooth harrow		122.050	146.360	68.870	112.411
Disc harrow		137.150	153.240	76.040	122.143
Least significant differences 5%		23.923			13.759

3.4Treatment Practical depth (Cm):

Table 5 shows the effect of the equipment type on thetreatment practical depth(Cm). The table shows that the land plane recorded the lowest treatment practical depth(16.259 Cm), while disc ridger and ditcher recorded (17.556, 18.926 Cm) respectively. The reason for that is difference in the working part for each equipment, and that related to the function for each equipment.

It is noted from the table that the tillage system using chisel plow recorded the lowest treatment practical depth (14.926 Cm), while other tillage systems that used the sweep plow and disk plow recorded atreatment practical depth equal to(17.444, 20.370 Cm) respectively.

The table also showed that the rotary harrow recorded the lowest average of treatment practical depth (16.815 Cm), while both of disc and the spring spike tooth harrow were recorded a treatment practical depth equal to (17.444, 18.482 Cm) respectively.

Result in table (5) indicated that land plane with chisel plow recorded a lowest average of treatment practical depth (13.778 Cm), while ditcher with disc plow recorded a highest average of treatment practical depth (22.333 Cm). Also, the results showed that land plane with rotary harrow recorded a lowest average of treatment practical depth(15.444 Cm), while ditcher with Spring spike tooth harrow recorded a highest average of treatment practical depth (20.111 Cm).

It is also can be noticed from the table the significance of the triple interference between (primary, secondary and special tillage equipment) on the equipment treatment practical depth.The lowest treatment practical depth (12.667 Cm) was recorded from the tillage system (land plane with rotary harrow and chisel plow), while the tillage system consists of (ditcher with spring spike tooth harrow and disc plow) showed the highest treatment practical depth (24.000 Cm).

Table (5). Effect of equipment type on the Treatment practical depth (Cm).

Primary equipment	Secondary equipment	Special equipment			Interference between primary and secondary equipment
		Disc Ridger	Ditcher	Land plane	
Disc Plow	Rotary Harrow	19.000	21.000	17.333	19.111
	Spring spike tooth harrow	21.000	24.000	19.667	21.556
	Disc harrow	20.333	22.000	19.000	20.444
Sweep Plow	Rotary Harrow	17.000	17.667	16.333	17.000
	Spring spike tooth harrow	18.333	19.667	16.333	18.111
	Disc harrow	17.000	18.333	16.333	17.222
Chisel Plow	Rotary Harrow	15.000	15.333	12.667	14.333
	Spring spike tooth harrow	15.667	16.667	15.000	15.778
	Disc harrow	14.667	15.667	13.667	14.667
Least significant differences 5%		2.321			1.653
Special equipment Average		17.556	18.926	16.259	
Least significant differences 5%		0.663			
Primary equipment					
Disc Plow		20.111	22.333	18.667	20.370
Sweep Plow		17.444	18.556	16.333	17.444
Chisel Plow		15.111	15.889	13.778	14.926
Least significant differences 5%		1.402			0.663
Secondary equipment					
Rotary Harrow		17.000	18.000	15.444	16.815
Spring spike tooth harrow		18.333	20.111	17.000	18.482
Disc harrow		17.333	18.667	16.333	17.444
Least significant differences 5%		2.573			0.663

The results of this study indicated that land plane with chisel plow showed a superiority in recorded thehighest practical productivity (1.422 ha / hour), lowest fuel consumption (15.163 L / ha), lowestenergy requirements (60.076Kw. hour / ha) and the lowest average of treatment practical depth (13.778 Cm), also the results showed that land plane with rotary harrow recorded a higher practical productivity (1.418 ha / hour) and the lowest average of treatment practical depth (15.444Cm). As well as the land plane with rotary harrow and the chiselplow achieved the highest practical productivity (1.437 ha / hour) and the lowest treatment practical depth (12.667 cm), and the lowest energy requirement (55.890 Kw. hour / ha). While the ditcher with spring spike tooth harrow and disk plow achieved the lowestpractical productivity (0.627 ha / hour) and the highest treatment practical depth (24.000 cm), in addition, the ditcher with disc harrow and disc plow achieved the highest fuel consumption (42.363 L / ha) and the highest energyrequirement (171.020 Kw. hour / ha).

It can be concluded that land plane with rotary harrow and chisel plow was the best in achieving the higher value of practical productivity, also land plane with spring spike tooth harrow and chisel plow achieved the lower value of fuel consumption and lower energy requirement.

We recommend conductingfurther researches and studies using other types of tillage systems (tractors and equipment) to estimate their energy requirement and calculate their practical productivity by testing them on different types of soils textures to obtain an integrated assessment of these systems.

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