POWER, WEIGHT TRACTOR AND DRAWBAR PULL RELATIONSHIPS DURING FIELD OPERATIONS

By

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ABSTRACT

Hussein Abbas Jebur: Power, Weight Tractor and Drawbar Pull Relationships During Field Operations. Unpublished Ph. D. Thesis, Department of Agricultural Engineering, Faculty of Agriculture, Ain Shams University, 2013.

The general objectives of this study were to investigate the performance characteristics of a farm tractor during ploughing (chisel plough) and sowing (seed drill) using variable weights (from 0 to 500 kg) on the rear tractor wheels, and different traveling speeds (from 2.78 to 5.68 km/h). The plowing depths were (15-20 cm), and the average moisture content was (20.15 %). The soil texture was found to be a silty clay. The rear tier sizes of the tractor and inflation pressure were 16.9/14-38 and 150 kPa, respectively. The study was concentrated on the rate of fuel consumption, required power, specific energy, drawbar pull, tractor wheel slippage, tractive efficiency, effective field capacity and field efficiency. The obtained results, for the range of tests, showed that the use of 500 kg weight on the tractor rear wheel at 3.1 km/h traveling speed produced the highest value (74.4 %) of tractive efficiency, in case of chisel plough operation, and (in the mean time) the wheel slippage, filed efficiency, fuel consumption, required power, specific energy were 7.46 %, 80.22%, 15.11 l/h, 46.58 kW, and 43.13 kW.h/fed, respectively. While in case of seed drill operation, the use of 500 kg weight at 3.07 km/h traveling speed produced the highest value (57.7 %) of tractive efficiency, and while the wheel slippage, filed efficiency, fuel consumption, required power, specific energy were 2.84 %, 76.55 %, 4.63 l/h, 14.27 kW, and 8.25 kW.h/fed, respectively. In general, the traveling speed and the weight on the rear tractor wheels were the most important factors that affecting the drawbar pull and the specific energy.

Key words: Tractor, Energy, Chisel plow, Seed drill, Weight.

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Hussein A. Jebur

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Abbreviation	Definition	Page No.
TS	Traveling speed, Km/h.	38
x	traveled distance, m.	38
t	Traveled time, s.	38
V	Volume of consumed fuel in glass bulb, (ml)	39
t	Time of running the test , (sec)	39
FC	Rate of volumetric fuel consumption, ($L.h^{-1}$).	39
D.S.FC	Drawbar specific fuel consumption, (l/kW.h)	39
P	drawbar power	39
BD	Soil bulk density (G/cm^3)	40
W_d	Dry soil mass (g)	40
T_v	Total soil volume (cm^3)	40
Mc	Soil moisture content	40
W_w	Wet soil mass, gm	40
W_d	Dry soil mass, gm	40
S	Wheel slip, %	40
TS_2	Traveling speed with load km/h	40
TS_1	Traveling speed without load km/h	40
η_f	Field efficiency,%	41
$E_{f.c}$	Effective field capacity, fed/h	41
$T_{f.c}$	Theoretical Field capacity, fed/h	41
P_{db}	Drawbar power (kW)	43
P_{rr}	Rolling resistance power (kW)	43
P_{sl}	Power consumed by slip (kW)	43
TE	Tractive efficiency %	43
R.E.P	Requirements engine power from Fuel consumption; kW	43

ρ_f	Density of the fuel; Kg/L (for diesel fuel = 0.85 Kg/L)	43
L.C.V	Lower calorific value of fuel Kcal/Kg; (average L.C.V of diesel fuel is 10^4 Kcal/Kg)	43
427	Thermo – Mechanical equivalent; Kg m/ Kcal	43
η_{th}	Thermal efficiency of the engine (assumed to be 40% for diesel engine)	43
η_m	Mechanical efficiency of the engine (assumed to be 80% for diesel engine).	44
SE	Specific energy, kW.h/fed. While, in case of using trailer operation unit of specific energy will be (kW.h/ton)	44
$E_{f.c}$	Effective field capacity, fed/h or ton/h	44
R^2	Regression of determination	٤٧

1. INTRODUCTION

Tractor is the main source of power at the farm and its population in a region is a good indicator of level of that area. The tractor is considered the hub of agricultural mechanization as it can be used to operate t agricultural implements, and its power on farm will continue to be an absolute necessity for increasing agricultural production. It is useful for field work, materials handling, and processing operation on farm.

Today tractor has become the most important prime move for completion of agricultural operation timely and its alleviate the drudgery associated with various farm operations and making the farm practices as pleasant job especially for the younger generation to adopt farming as professions.

Use of tractors ensures better quality of work of farm operations timely completion of farm activities, better management and supervision.

One of the major concerns for farmers today is the cost of farm tractor energy. Energy consumption of farm tractor can be reduced through better designs for tractors, better matching of tractors to implements, and better tractor operating procedures.

As energy is more expensive, its efficient utilization in agricultural production system has become a major concern to agricultural engineer and tractor owners. The reduction of energy consumption in farm operations depends upon the matching of tractors to implement and their operating characteristic. Therefore, the present study aims to investigate, test and evaluate the relationships between power, weight, drawbar pull and traveling speed of farm tractor during ploughing, sowing, and transporting operations using chisel plough, seed drill, and agricultural tractor-trailer, respectively, with the use of different weights on the rear

tractor wheels and different traveling speeds through the following specific objectives:

1. Determination the wheel slippage.
2. Determination the drawbar pull.
3. Determination the tractive efficiency.
4. Determination the fuel consumption, required power and specific energy.
5. Determination the effective field capacity and field efficiency.