EFFECT OF CONSTRUCTING AND OPERATING FACTORS ON THE FIELD PERFORMANCE OF THE TRACTOR

By

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B. Sc. Agric. Sc. (Agric. Mechanization), Basrah University, 1991.

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A thesis submitted in partial fulfillment

of

the requirements for the degree of

DOCTOR OF PHILOSOPHY

in

Agricultural Sciences

(Farm Machinery and Power Engineering)

Department of Agricultural Engineering

Faculty of Agriculture

Ain Shams University

2015

Approval Sheet

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ABSTRACT

Majed Salih Himoud*:* Effect of Constructing and Operating Factors on the Field Performance of the Tractor. Unpublished Ph.D. Thesis, Department of Agricultural Engineering, Faculty of Agriculture, Ain Shams University, 2015.

The effect of forward speed, inflation pressure of rear wheels and soil moisture on the tractor field performance has been investigated in this study during ploughing by using moldboard plough in order to evaluate the drawbar pull, tractor wheel slippage tractive efficiency, the required power, specific energy, effective field capacity, field efficiency, and fuel consumption. The experiments were carried out using four different forward speeds (1.8, 2.33, 3.88 and 4.68 km/h) of Massey Ferguson 285s, three inflation pressures of rear wheel (50, 100, 150 kPa), the average soil moisture content M_{cdb} (14.67%, 24.18 %) dry basis, and the average of ploughing depths (from 10 to 20 cm). The soil texture was found to be silty clay. The results for the range of tests, showed that the maximum attractive efficiency was obtained at 3.67 km/h travelling speed, 14.67%(M_{cbd}) ,100 kPa inflation pressure of tractor rear wheels, while the drawbar pull, wheel slippage, effective field capacity, field efficiency, rate of fuel consumption, required power and specific energy were 10.60kN .5.58%, 1.45 fed /h, 77%, 8L/h, 25.55 kW and 17.02 kW.h/fed respectively.

***Key words** : Tractor , inflation pressure , tractive efficiency , forward speeds*

ACKNOWLEDGEMENT

This work would never have materialized without the contribution of many people to whom I have the pleasure of expressing my appreciation and gratitude.

Before

I would like to express my special thanks to my Thesis advisors **Prof. Dr. Mubarak Mohamed Mostafa**, **Prof. Mahmoud Ahmed Elnono** and **Dr. Essam Ahmed El-Sahhar,** who accepted the challenge to guide me through the development of this thesis and who made it possible for me to complete the thesis. Their cooperation, wise advice, suggestion and guidance through the continuous have brought me to the point of successfully completion this thesis work.

Great thanks to all staff members of Agricultural Engineering Dep., Fac. of Agric., Ain Shams Univ., for kindness help.

Great thanks to all staff members of Agricultural Machines and Equipment Dep., Fac. of Agric., Basrah Univ ., for kindness help.

It is my prerogative to express my gratitude to my university, the Basra University, Iraq, for giving me the opportunity to study at Ain Shames University, Egypt.

Finally, I wish to express my deepest appreciation to my family (spirit of my father and my mother), , my wife, and my son, for their continuous encouragement and support

Majed S. Himoud

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Abbreviation	Definition	page
M_{cbd}	Soil moisture content (dry basis) %	26
W_d	dry soil mass, gm	26
W_w	wet soil mass, gm	26
TS	travelling speed,(km/h)	28
V	volume of consumed fuel in glass bulb (ml)	30
t	time of running the test , (sec)	30
F.C	rate of volumetric fuel consumption, (L/h).	30
S	wheel slip, %	30
TS_1	traveling speed without load km/h.	30
TS_2	traveling speed with load km/h.	30
D.S.F.C	Drawbar specific fuel consumption (l/kW.h)	30
P	drawbar power (kW).	30
P_{db}	Drawbar power (kW)	38
Dp	drawbar pull (kN)	30
TE	tractive efficiency %	30
η_f	Field efficiency,%	31
Ef.c	Effective field capacity, fed/h.	31
Tf.c	Theoretical Field capacity, fed/h.	31

$R.E.P$	Power Requirements from Fuel consumption; kW.	31
Fc	Fuel consumption rate; L/h	31
ρ_f	Density of the fuel; kg/L (for diesel fuel = 0.85 kg/L)	31
L.C.V	Lower calorific value of fuel Kcal/Kg; (average L.C.V of diesel fuel is 104 Kcal/Kg)	31
427	Thermo–Mechanical equivalent;.kg.m/kcal;	31
η_{th}	Thermal efficiency of the engine (assumed to be 40% for diesel engine)	31
η_m	Mechanical efficiency of the engine (assumed to be 80% for diesel engine)	31
SE	specific energy, kW.h/fed.	32
R.E.P	power required for a particular operation, kW.	32
$E_{f.c}$	effective field capacity, fed/h.	32

1. INTRODUCTION

Nowadays, energy consumption is one of the word interests, implement consume large amount of energy used in agricultural mechanization systems.

The field performance operation of tractor is limited by constructing and operation factors as power supplied from the engine to the drive wheels.

In order to have a feasible operation, .The power supplied by the engine must be enough to meet the pull requirement of the implement at given working condition which include the strength of the soil , depth of operation and working speed.

Also the important limiting factor is the traction developed by the drive wheels on interaction with the soil. This traction depends upon the tire and soil characteristic.

The fuel consumption considered as one the factor that is used to evaluate the performance of tractors in field. The knowing the fuel consumption in studying the technical effects and economic costs for mechanization unit is the most important factor . The consideration of tractor fuel consumption in tillage operations using mouldboard at various depths and ploughing speeds despite were therefore examined in a bid to minimize operating costs and maximize farm profit margins. The fact that cost of fuel constitute over 70% of tractor operating costs **Al-Suhaibani et al. (2009)**

The aim of this investigation is to find out the field performance of tractor requirement under agricultural condition .this will definitely be of great help to farmers and users.

Consequently, the present work is mainly concerned with testing, the field tractor performance including tillage operation at different forward speed, inflation pressure of rear wheels, and soil moisture content .It also determines and discusses the following objective

1-The field tractor performance including tillage operation with some soil physical properties and inflation pressure.

2-Slippage, rolling resistance, power requirement and specific energy .

3-Effective field capacity and field efficiency.

4- The fuel consumption and economic evaluation in order to get the optimum tractor field performance.

2. REVIEW OF LITERATURE

Tractor is used as a source of mobile power in agriculture and industry .since tractor is much important tools ,it is necessary use . plowing operations is one of the most important factors controlling the suitability of power required for agriculture activities . Before selecting the tractor size , tractor performance in local conditions must be taken into consideration .

2.1 Traction and Factors affecting

There has been an intensified increase in the relation between the performance of the tractors and the surface on which they operate.

Taylor et. al. (1967) showed that the greatest variation in pull came from the differences in the soil or traction conditions.

Zoz (1974) indicated that the increase in field operations can be accomplished in at least three ways:

1. Increasing sized and width of machine.

2. Increasing forward speeds.

3. Combining operations to limit the number of trips across the field.

Bashford et. al. (1985) said that the influence of tractor forward speed on traction performance varied as a function of test conditions.

Al- Janobi et. al. (2002) showed that forward speed and implement depth have sigvenificant effect on dynamic traction ratio of tractor.

Mehta et. al. (2010) Indicated that the tractor is used for various field operations. Therefore, it is recommended that the field operations which is the most time sensitive or that require the highest power should be taken into consideration for determining the power of tractor.

Lyasko (2010) Indicated that the soil conditions significantly affect on tractive performance of off-road wheeled and tracked vehicles.

Sahay and Tewari (2004) mentioned that the satisfactory performance of the tractor-implement system is dependent upon the stability of the operation, power of the engine and traction developed. Each of these attributes is dependent upon a number of variables.

The right choice of tire size is a matter of great importance in the design and operation of off-road wheeled vehicles **(Gee-Clough, 1980)**.

Biondi and Maraziti (1997) indicated that the traction force depends in turn on the tractive coefficient between surface and traction device (a function of slip) and on the normal load on the traction device. On a plane, the drawbar pull is equal to the tractive effort exertable at the periphery of the traction device, less the resistance to motion.

Hashish et. al. (1997) compared traction performance between two and four wheel drive tractor on a sandy soil and three soil conditions, with two sizes of rear wheel, fuel consumption; specific fuel consumption and slippage were measured. The results showed that the four- wheel drive tractor with rear tire size of $14.00^{*}38$ improved the traction power and slippage. Also, it also saved and improved the specific fuel consumption than the two wheel drive tractor with $18.40^{*}30$ rear tire size.

Burt et. al. (1983) stated that research results throughout the world show that from 20 to 25 % of the energy delivered to drive wheels of tractors is wasted in their traction elements. They conducted field test to