

PROCEEDING BOOK

26-29 APRIL 2018

KASTAMONU - TURKEY

INTERNATIONAL CONGRESS ON ENGINEERING AND LIFE SCIENCE

PROCEEDING BOOK

26-29 April 2018, Kastamonu/TURKEY

ISBN: 978-605-4697-20-5

Editors

Assoc. Prof. Dr. Adem Yavuz SÖNMEZ

Assoc. Prof. Dr. Soner BİLEN

Assist. Prof. Dr. Ertuğrul TERZİ

Assist. Prof. Dr. Ali Eslem KADAK

Published on 26/10/2018

Republic of Turkey

Kastamonu University-2018

CONTENTS

INTRODUCTION **II**

CONGRESS COMMITTEE **VII**

CONTENTS **1**

ORAL PRESENTATIONS **7**

POSTER PRESENTATIONS **939**

CONTENTS

Contents 1

ORAL PRESENTATIONS

Traditional Foods and Food Safety 7

Evaluation of the Usability of Fly ash as Raw and Filling Materials in Turkey 10

Heavy Metal Concentrations in Sepiolite Samples from Central Anatolia Region of Turkey 12

Investigation of the Effects of Region Animal Husbandry and Economy of Neonatal Period Calf Diarrhea in Narman County of Erzurum Province 15

Probiotic and Humate Effects on Performance Parameters in Milk Suckling Period of Calves 18

An Overview on Meat Production of Livestock in the World and in Turkey 22

Evaluation of Learning Forms of Students Based on Data Mining: Bartın Vocational School Example 25

Evaluation of Employee's Happiness by Data Mining and Statistical Methods in the Process of Internal Public Relations 29

Awareness of Ecological Corridor Notion at Landscape Architecture Undergraduate Level: Case of Kastamonu University - Bartın University 33

Importance of Hadron Colliders in High Energy Physics 39

Theoretical Evaluation of W Boson Differential Cross Section at 8 Tev Center of Mass Energy 42

The Effect of Transglutaminase Enzyme on Physico-Chemical, Microbiological, Sensory and Textural Properties of Pastırma 44

Zn: Fe_2O_3, Mg: Fe_2O_3 and Fe_2O_3 Thin Films Grown by Spray Pyrolysis and Gas Sensor Application 48

Investigation of Electrical Properties of Gase Single Crystal Depending on Temperature 53

Investigation of Antioxidant Properties of Ethanol, Methanol and Ethyl Acetate Extracts of Different Parts of Endemic *Achillea teretifolia* (Civan Perçemi) from Gümüşhane 58

Investigation on Antibacterial Activity of a *Dianthus* Species 61

Plant Cell Wall Proteins: Arabinogalactans 64

Essential Oils Compounds of Seed of Palm (*Phoneix dactylifera*) Grown in Libya 68

Determination of the Secondary Metabolite Production Potential of Marine-Derived Actinomycetes by Molecular Techniques 72

Terahertz Intersubband Photodetectors Based on GaN/AlGan Materials 75

Myxozoan Parasites of Some Teleost Fishes in the Black Sea 80

Current Status of Myxosporean (Cnidaria: Myxozoa) Parasites of Marine and Freshwater Fishes in Turkey 83

Infections of *Ortholinea mullusi* and *Myxobolus* Sp. (Cnidaria: Myxozoa) in *Mullus barbatus* (Mullidae) 89

The Evaluation of the Effectiveness Level of Management in the Soğuksu and Yozgat Çamliği National Parks 92

Comparison of Different Extraction Methods for the Extraction of Tannin from Taurus Cedar Bark 97

The Investigations of Excavation Techniques of Bulldozer at Forest Road Construction (A Case Study of Gursu Forest Enterprises) 101

Grafted-Rooted Vine Production by a New Motorized Grafting Machine 107

Investigation of Specific Surface Area and Pore Size Distribution Changes of $CaSO_4$ in the Presence of Poly (Sodium 4-Styrenesulfonate) 113

Effect of Parameters on Borax Extraction from Ulexite at Atmospheric Pressure 117

Sustainable Urban Open-Green Areas and Xeriscape Approach: The Example of Nevşehir 122

The Impact of Orköy Activities of the Giresun Regional Directorate of Forestry on Sustainable Rural Development 129

One-Step Microwave Energy-Based Nano-Manufacturing of a Hybrid Electrode Material and Its Use in Energy Storage 835

A Comparison of Fatline Widths 839

A Test Bench for Electrical Motor and Propeller Components of a Lightweight Quadcopter 844

Student Attendance Systems Supported by Intelligent Mobile Telephones 851

In Vitro Inhibition of Azithromycin and Amikacin Sulphate Used as Anti-infective Drug on Human Serum Paraoxanase 1 Enzyme Activity 858

Effect of Using Different Hypotonic Solution for Chromosome Preparation from Embryonic Tissues of Rainbow Trout (Oncorhynchus mykiss) Larvae 862

From Past to the Present Small Ruminant Husbandry in Kastamonu 864

Recent Developments in Turkish Dairy Goat Farming 875

An Overview Some Metabolic Diseases and Fertility Disorders in Organic Dairy Herds 880

Additions to the Knowledge of Injurious Mites Living on Garlic in Kastamonu/TURKEY 884

Marketing Structure of Fresh Fruit and Vegetable in Turkey 888

Comparison of the Energy Requirements of Standard Mouldboard Plough, Conventional Reversible Mouldboard Plough and Swing Plough 892

Predicting Draft Power and Specific Energy Requirement of Cylindroid Mouldboard Plough 896

Determination of Percent Crop Residue Cover by Drone and Image Processing Method in Wheat Field After Harvesting* 900

Evaluating Afşin-Elbistan Fly Ash as Geopolymer Concrete Raw Material with Blast Furnace Slag Incorporation 905

Investigating the Effectiveness of Some Mineral Materials on Residual Strength of Concretes After Fire: A Taguchi Analyze 911

Thermodynamic Analysis of Waste Heat Recovery System in Glass Industry 918

Performance Analysis of Isopentane, R123, and R141b for Organic Rankine Cycle Used in Waste Heat Recovery System 923

Effects of Convective Hot Air Drying on Drying Characteristics, Colour, Total Phenolic Content and Antioxidant Capacity of Carrot Slices 930

POSTER PRESENTATIONS

Multiband Microstrip Patch Antenna for Automobile Radars 939

Anthropogenic Biomes (Anthromes) of Turkey 944

Methanation of Carbondioxide Over the Nay-Zeolite and Molecular Sieve Supported Nio Composed Catalysts 947

Accurate Modeling for Photovoltaic Modules 950

Effect of Nitrate and/Or Nitrite on Free Amino Acid Composition of Pastırma 955

Evaluation of Agro-Industrial Wastes as Prebiotic 958

Attention to Saffron (*Crocus sativus* L.) with Various aspects and Possibility of Growing in Kastamonu 961

Low-Fat Foods: Functionality of Fat Replacers 964

Place of Utility Principle in Environmental Law and the Approach of the Judge in Terms of Utility About Nature 967

ORAL PRESENTATIONS

Comparison of the Energy Requirements of Standard Mouldboard Plough, Conventional Reversible Mouldboard Plough and Swing Plough

Ergin DURSUN, İlknur DURSUN*
Ankara University, Faculty of Agriculture, Department of Agricultural Machinery and Technologies Engineering, Ankara-TURKEY
***Corresponding Author:** dursun@agri.ankara.edu.tr*

Abstract: Mouldboard ploughs are used widely for primary tillage. There are two types of mouldboard ploughs according to turn the furrow slices: one-way version and a two-way version. One-way versions are designed to turn the furrow slices only to the right. Two-way versions or reversible mouldboard ploughs are designed to turn the furrow slices to the right and left. The two sets of bottoms are mounted on a common frame that is rotated 180º about a longitudinal axis to change from one set to the other. The swing plough was developed as an alternative to the conventional reversible mouldboard plough. The energy requirements of mouldboard ploughs are high. Energy requirement of mouldboard ploughs depend on working depth of the plough, working witdh, number of bottoms, type of mouldboard, soil moisture content, soil bulk density, draft force, soil penetration resistance, forward speed. This study aimed at comparing total energy requirement in relation to the inputs of fuel-oil energy, machine production energy and human labour energy for the standard mouldboard plough, conventional reversible mouldboard plough and swing plough. Mouldboards of standard mouldboard plough and conventional reversible plough used in the study have cylindroid and the bottoms of swing plough have square shaped. The ploughs examined are tractor mounted type and have two bottoms. The total weights of standard mouldboard plough, conventional reversible mouldboard plough and swing plows are 205, 402 and 270 daN respectively. During the tests, the ploughs was operated at 25 cm average furrow depth in condition of medium heavy soil. Fuel-oil energy, machine production energy, human labour energy and total energy requirement of ploughs were calculated by using equations. As a result of the study, it was determined that the total energy requirement per unit area (926.00 MJ ha^{-1}) of the swing plough was lower than the standard mouldboard plough (1085.49 MJ ha^{-1}) and conventional reversible plough (1244.25 MJ ha^{-1}). The total energy requirement of the swing plough is 14.69% less than that of the standard mouldboard plough and 25.58% less than that of the conventional reversible plough.

Keywords: Standard mouldboard plough, conventional reversible mouldboard plough, swing plough, ploughing, total energy requirement

1.INTRODUCTION

Soil tillage is the first stage in crop production. Soil tillage may be defined as the obtaining of desired conditions by moving the soil with mechanical manuplation by means of soil tillage tools and machines according to the needs of the plant starting from seedbed preparation (Dursun, 2015). Various tools and machines are used in soil tillage operation. These are consisted of mouldboard ploughs, disc plough, subsoilers, chisels, listers, field cultivators, disc harrows, rollers, scrubbers, etc. Depending on the type of tools and machine used, the soil is inversed, shatterd, mixed, aerated or compacted.

Nowadays conservation tillage methods for soil and water conservation have gained importance. No-till is one of the conservation tillage methods. However,mouldboard plough is the most widely used basic tillage tool in our country as in the world. Ploughs are generally divided into two types, mouldboard plough and disc plough. According to the statistics of the year 2017, total number of mouldboard ploughs are 1071553 in Turkey (Anonymous, 2018). The number of mouldboard plough per tractor is 0.82. There are two types of mouldboard ploughs according to turn the furrow slices: one-way version and a two-way version (Gökçebay, 1986). Mostly, one-way versions are used. One-way versions are designed to turn the furrow slices only to the right. Two-way versions or reversible mouldboard ploughs are designed to turn the furrow slices to the right and left. The reversible ploughing method has significant advantages. The method is simple and easy. Dividing of the field as the parcels is not necessary. Ridges and furrows do not form on the soil surface. Other agricultural tools and machines work more easily in the field. Seedbed preparation is more successful in precision sowing. Turning time and fuel consumption are less because of the short turns at the beginning of parcel (Dursun, 2015). However, the reversible ploughs have disavantages such as being heavy, high draft power requirement and high purchase price.

The energy requirements of mouldboard ploughs wich are the basic tillage tool in agricultural production are very high (Boydaş and Uygan, 2010). Specific energy requirements of mouldboard ploughs depend on such factors as working depth, working witdh, number of bottoms, type of mouldboard, soil moisture content, soil bulk density, soil penetrometer resistance and forward speed.

In this study, it was aimed at comparing the total energy requirements of the standard mouldboard plough, conventional reversible mouldboard plough and swing plough.

2.MATERIALS AND METHODS

In this study, 3 ploughs were selected as test material. These are standard mouldboard plough, conventional reversible mouldboard plough and swing plough. The swing plough was developed by Erol et al. (1996) within the scope of TUBITAK project (TOAG-1044) (Figure 1).



Figure 1. Swing plough

The ploughs examined are tractor mounted type and have two bottoms. The total weights of standard mouldboard plough, conventional reversible mouldboard plough and swing plough are 205, 402 and 270 daN, respectively. Mouldboards of standard mouldboard plough and conventional reversible plough have cylindroid and the bottoms of swing plough have square shaped (cylindric). Working witdh of swing plough can be adjusted to 720 mm, 800 mm and 870 mm. Working witdhs of standard mouldboard plough and conventional reversible mouldboard plough are 600 mm and 570 mm, respectively (Table 1). Table 2 shows some operating characteristics of these ploughs determined in medium heavy soil condition and at an average working depth of 25 cm. The soil moisture contents for 0-5 cm, 10-15 cm and 20-25 cm soil depths were measured as 15%, 23,9% and 23,2%, respectively. The penetrometer resistances for 10 cm, 15 cm, 20 cm and 25 cm soil depths were determined 0,61 MPa, 1,06 MPa, 1,23 MPa and 1,46 MPa, respectively. Fiat 480 standard tractor was used in the experiments (Erol et al., 1996).

Table 1. Some technical specifications of ploughs examined (Erol et al., 1996)

Technical specifications	Standard mouldboard plough	Conventional reversible plough	Swing plough
Total weight (daN)	205	402	270
Type of bottom/mouldboard	Silindroid	Silindroid	Square shaped (Cylindric)
Number of bottom	2	2	2
Total working witdh (mm)	600	570	720/800/870
Distance between bodies (mm)	750	605	600/700/800
Under beam clearance (mm)	650	750	700

Table 2. Some operating characteristics of ploughs examined (Erol et al., 1996)

Type of plough	Forward speed ($m\ s^{-1}$)	Effective motor power (kW)	Spesific motor power ($kW\ m^{-1}$)	Effective field capasity ($ha\ h^{-1}$)	Fuel consumption ($L\ ha^{-1}$)
Standard mouldboard plough	1.101	13.62	21.28	0.255	22.69
Conventional reversible mouldboard plough	1.100	14.06	23.84	0.234	25.24
Swing plough	1.067	14.02	17.52	0.307	19.20

Fuel-oil energy, machine production energy and human labour energy were calculated in order to compare the total energy requirements of ploughs examined in ploughing. The fuel energy and oil energy inputs were calculated from equations 1 and 2, respectively (Gözübüyük et al., 2012):

$$FE = FC \cdot EVF \quad (1)$$
$$OE = [FC \cdot (0{,}045)] \cdot EVO \quad (2)$$

In equations;
FE: Fuel energy input (MJ ha^{-1}),
OE: Oil energy input (MJ ha^{-1}),
FC: Fuel consumption (L ha^{-1}),
EVF: Energy value of fuel (MJ L^{-1}),
EVO: Energy value of oil (MJ L^{-1}).
The machine production energy input was calculated from the following equation (Karaağaç et al., 2012):

$$MEI = (E \cdot W) / (EFC \cdot T) \quad (3)$$

In equation;
MEI: Tractor or tool-machine production energy input (MJ ha^{-1}),
W: Weight of tractor or tool-machine (daN),
E: Production energy of unit weight of tractor or tool-machine (MJ daN^{-1}),
T: Economical lifes of tractor or tool-machine (h),
EFC: Effective field capasity başarısı (ha h^{-1}).
Human labour energy input was calculated from equation 4 (Gözübüyük et al., 2012):

$$HLE = HLWF \cdot UHLE \quad (4)$$

In equation;
HLE: Human labour energy input (MJ ha^{-1}),
HLWF: Human labour workforce used in unit area (h ha^{-1}),
UHLE: Unit human labour energy equivalent (MJ h^{-1}).

The energy equivalents were taken as 39,60 MJ L^{-1} (Rathke and Diepenbrock, 2006) and 6,51 MJ L^{-1}, respectively, while the fuel-oil energies were calculated (Ejilah and Asere, 2008). The energy equivalents for producing unit weights of tractor and ploughs were taken as 158,5 MJ h^{-1} and 121,30 MJ h^{-1}, respectively, while the machine production energies were calculated (Gözübüyük et al., 2012). Unit human labour energy equivalent was assumed as 1,96 MJ h^{-1} (Davoodi and Houshyar, 2009). In addition, the economical life for tractor was taken as 10000 h and the economical life for ploughs was taken as 2500 h when the energy inputs and tractor or tool-machine (ploughs) were calculated (Evcim, 19901).

3.RESULTS AND DISCUSSION

The energy requirements for ploughing with standard mouldboard plough, conventional reversible mouldboard plough and swing plough were given in Table 3.

Table 3. The energy requirements of standard mouldboard plough, conventional reversible mouldboard plough and swing plough (MJ ha^{-1})

Type of plough	Fuel-oil energy	Machine production energy *	Human labour energy	Total energy
Standard mouldboard plough	905.17	172.64	7.68	1085.49
Conventional reversible mouldboard plough	1006.89	228.99	8.37	1244.25
Swing plough	765.94	153.67	6.39	926.00

*Plough+tractor

The highest fuel-oil energy (905.17 MJ ha^{-1}) was obtained working with conventional reversible mouldboard plough. The lowest fuel-oil energy (765.94 MJ ha^{-1}) was obtained working with swing plough.

The highest input energy used for machine production in unit area was obtained for conventional reversible mouldboard plough, the lowest value was obtained for swing plough. The energy input for machine production for conventional swing plough is 153.67 MJ ha^{-1}. This value is 172.64 MJ ha^{-1} for the standard mouldboard plough and 228.99 MJ ha^{-1} for conventional reversible mouldboard plough.
In terms of human labour energy input required, the lowest value was obtained with swing plough as 6.39 MJ ha^{-1}, while the highest value was obtained with conventional reversible mouldboard plough as 8.37 MJ ha^{-1}.
When the total energy input used was examined, it was seen that the highest value belongs to the conventional reversible mouldboard plough with 1244.25 MJ ha^{-1} and lowest value belongs to the swing plough with 926.00 MJ ha^{-1}.

4.CONCLUSION

When the results obtained from this study are evaluated in general, it was seen that the total energy requirement per unit area of the swing plough used for soil tillage was lower that than of the standard mouldboard plough and conventional reversible mouldboard plough. The total energy requirement of the swing plough is 14,69% less than that of the standard mouldboard plough and 25,58% less than that of the conventional reversible plough. This difference was due to the fact that the energy used for the production of the used tractor is excluded, especially due to the high level of effective field capasity combined with the energy required for plough production, low fuel consumption and human labour requirements. This case increase the widespread use chance of swing plough which has been developed as an alternative to the conventional reversible plough. The most impartant disadvantages of the conventional reversible plough are high weight, cost and fuel consumption. However, the swing plough is both more light and has less total energy consumption per unit area.

REFERENCES

Boydaş, M. G. and Uygan, F., 2010. Kulaklı pullukta çeki kuvvetine etki eden faktörler. 26. Tarımsal Mekanizasyon Ulusal Kongresi, 22-23 Eylül, 235-242, Hatay.

Davoodi, M. J. Ş. and Housyar, E., 2009. Energy consumption of canola and sunflower production in Iran. American-Eurasian Journal of Agricultural & Environmental Sciences 6(4): 381-384.

Dursun, İ. 2015. Toprak İşleme Alet ve Makinaları. Ankara Üniversitesi Basımevi, Ankara Üniversitesi Ziraat Fakültesi, Yayın No: 1618, Ders Kitabı: 570, Ankara.

Ejilah, I. R. and Asere, A. A., 2008. A comparative performance and emission analysis of blended groundnut oil and mineral oil based lubricants using a spark ignition engine. Agricultural Engineering International: The CIGR E journal manuscript EE 07017. Vol. X.

Erol, M. A., Göknur Dursun, İ. and Dursun, E., 1996. Kaydırmalı Pulluk Geliştirilmesi. Tarım Orman ve Gıda Teknolojileri Araştırma Grubu, TOAG-1044, Proje Sonuç Raporu, Ankara.

Evcim, Ü., 1990. Tarımsal Mekanizasyon İşletmeciliği ve Planlaması Veri Tabanı. Ege Üniversitesi Ziraat Fakültesi, Yayın No: 495, İzmir.

Gökçebay, B., 1986. Tarım Makinaları I. Ankara Üniversitesi Ziraat Fakültesi Yayınları: 979, Ders Kitabı: 289, Ankara.

Gözübüyük, Z., Çelik, A., Öztürk, İ., Demir, O. and Adıgüzel, M. C., 2012. Buğday üretiminde farklı, toprak işleme- ekim sistemlerinin enerji kullanım etkinliği yönünden karşılaştırılması. Tarım Makineleri Bilimi Dergisi, 8 (1) : 25-34.

Karaağaç, H. A., Aykanat, S., Coşkun, M. A. and Şimşek, M., 2012. Buğday tarımında farklı ekim tekniklerinin enerji bilançosu. 27. Tarımsal Mekanizasyon Ulusal Kongresi Bildiri Kitabı: 5-7 Eylül 2012, Samsun.

Rathke, G.W. and Diepenbrock, W., 2006. Energy balance of winter oilseed rape (*Brassica napus* L.) cropping as related to nitrogen supply and preceding crop. European Journal of Agronomy 24: 35-44.

TÜİK, 2018. Tarımsal Alet ve Makine Sayısı, 1998-2015. Retrieved in Mars, 29, 2018 from http://www.tuik.gov.tr/VeriBilgi.do?alt_id=1006.

INTERNATIONAL CONGRESS ON ENGINEERING AND LIFE SCIENCE
ICELIS 26-29 APRIL 2018

Predicting Draft Power and Specific Energy Requirement of Cylindroid Mouldboard Plough

İlknur DURSUN, Ergin DURSUN*
Ankara University, Faculty of Agriculture, Department of Agricultural Machinery and Technologies Engineering, Ankara-TURKEY
***Corresponding Author:** edursun@agri.ankara.edu.tr*

Abstract: Mouldboard plough is primary tillage implement used in conventional tillage. It is one of the equipment that needs high draft power and specific energy. Predicting the draft power and specific energy requirement of mouldboard ploughs depending on technical properties of the plough, the physico-mechanical properties of the soil and the working conditions before the soil tillage will be useful in terms of energy saving. This study aimed at predicting draft power and specific energy requirement of cylindroid mouldboard ploughs in medium heavy soil conditions. For this purpose prediction equations were developed to calculate draft power and spesific energy requirement of mouldboard plough. The prediction equations were developed based on dependent variables such as soil parameters including penetrometer resistance, bulk density and moisture content, working witdh, working depth, forward speed and field capacity. Equation 1 for predicting the draft power in medium heavy soil conditions and Equation 2 for predicting of the penetrometer resistance of medium heavy soil working with cylindroid mouldboard ploughs were used. The draft power obtained from Equation 3 was rated to the field capacity to predict specific energy requirement of mouldboard plough. As a result, a basic Equation 4 for predicting the specific energy requirement of the mouldboard plough was obtained. To test the reliability of the developed prediction equations, the regression coefficients between the results from prediction equations and some other research results were determined. The study showed that draft power and specific energy requirement could be successfully predicted by the prediction equations with good accuracy when working in medium heavy soil condition with cylindroid mouldboard ploughs. The regression coefficients of relationship between predicted and measured draft power of mouldboard ploughs were varied from 0.948 to 0.996. The regression coefficient of relationship between predicted and measured specific energy requirement of mouldboard ploughs was 0.924.

Keywords: Cylindroid mouldboard plough, soil tillage, draft power, specific energy, prediction equations

1.INTRODUCTION

Soil tillage is one of the most important operations in crop production. The mouldboard ploughs are the most common primary tillage implement in agriculture and widely used for conventional tillage all over the world. They cut off strips of soil called furrow slices, invert and crush them on the active surface consisting of the share and mouldboard in horizontal and vertical planes. As a result of being inverted, furrow slices are displaced and lied against the previous turned furrow slice (Bernacki et al., 1972; Dursun, 2015). There are many different types of mouldboards and the effects to the soil change depending on their types.

Mouldboard ploughs may produce undesirable effects such as increasing soil erosion, loss of soil moisture content, worsening of soil structure due to compaction, and increasing carbon dioxide (CO_2) release into the atmosphere from soil in case of unconscious use. However, despite all these undesirable effects it is recommended that the soil tillage with a mouldboard plough every 4 or 5 years even in no-till method (Dursun, 2015).

Mouldboard ploughs are widely used in conventional tillage in Turkey. According to the statistics of the year 2017, total number of mouldboard ploughs is 1071553 in Turkey (TÜİK, 2018). The number of mouldboard ploughs per tractor is 0.82. However, mouldboard ploughs are one of the highest energy consuming primary tillage implements (Boydaş and Uygan, 2010).

Many studies have been conducted to compare the draft power and energy requirement of different types of mouldboard ploughs as well as the other tillage implements under various conditions. Kheiralla et al. (2003) explained that the specific energy requirements of mouldboard plough, disc plough, rotary tiller and disk harrow were 157.68 MJ ha^{-1}, 151.56 MJ ha^{-1}, and 105.12 MJ ha^{-1} and 66.60 MJ ha^{-1}, respectively at condition of 10-12 cm working depth in sandy clay loam soil condition. The specific energy of the mouldboard plough and the disc plough were higher than that of the rotary tiller 50 and 44%, respectively (Kheiralla et al., 2003).

Some mathematical models have been developed to predict draft force, draft power and specific energy requirement of mouldboard ploughs. The draft power and specific energy requirement of mouldboard ploughs is affected by many factors, such as working depth, working witdh, the type and shape of plough body, the sharpness of the share, the overall adjustment of the plough, forward speed, soil type and soil parameters consisted of moisture content, bulk density and penetrometer resistance. Prediction of the draft power and specific energy requirement for mouldboard ploughs could be

useful in terms of proper selection of tractors and ploughs, working at optimum operating conditions and increasing field capacity. Thus, energy inputs and costs for tillage operation could be minimized.
This study aimed at predicting draft power and specific energy requirement of cylindroid mouldboard ploughs in medium heavy soil condition.

2.MATERIALS AND METHODS

In this study the prediction equations were developed based on dependent variables such as soil parameters including penetrometer resistance, bulk density and moisture content, working witdh, working depth, forward speed and field capacity, medium heavy soil conditions. These prediction equations will be used to calculate draft power and spesific energy requirement of mouldboard plough.

Equation 1 is used for predicting the draft power of cylindroidal mouldboard (Göknur, 1995) and Equation 2 is used for predicting of the penetrometer resistance in medium heavy soil condition (Göknur Dursun and Dursun, 2000).

$$P = [[(71.78) \cdot CI] - (37.20)] \cdot a \cdot b \cdot n \cdot v^{1.5} \quad (1)$$

In equation;
P: Draft power (kW),
CI: Soil penetrometer resistance (MPa),
a: Working depth (m),
b: Working witdh (m),
n: Number of bottoms,
v: Forward speed (m s^{-1}).

$$CI = [a_{ö} \cdot P_b \cdot [(2.45) - [(0.71) / (a_{ö}^3 \cdot P_b)] - [(0.14) / a_{ö}]] + [(6.60) \cdot W_b] + (822.51)] / 10^{+3} \quad (2)$$

Where;
CI: Soil penetrometer resistance (MPa),
$a_{ö}$: Measurement depth (m),
P_b: Soil bulk density (daN m^{-3}),
W_b: Soil moisture content (%).
Göknur (1995) determined that regression coefficient of relationship between calculated draft power from Equation 1 and measured draft power was 0.978. Göknur Dursun and Dursun (2000) determined that regression coefficient of relationship between calculated from Equation 2 and measured penetrometer resistance was 0.904.
In order to estimate the draft power, Equation 2 was written instead of penetrometer resistance in Equation 1. Thus, Equation 3 was obtained. This approach will make easier to measure the penetrometer resistance of soil when the penetrometre is not available. In Equation 3, it was assumed that the working depth (a) of the mouldboard plough is equal to the measurement depth ($a_{ö}$) of the penetrometre.

$$P = [[(71,78) \cdot [[a \cdot P_b \cdot [(2.45) - [(0.71) / (a^3 \cdot P_b)] - [(0.14) / a]] + [(6.60) \cdot W_b] + (822.51)] / 10^{+3}]] - (37.20)] \cdot a \cdot b \cdot n \cdot v^{1.5} \quad (3)$$

In equation;
P: Draft power (kW),
a: Working depth (m),
b: Working witdh (m),
n: Number of bottoms,
v: Forward speed (m s^{-1}),
P_b: Soil bulk density (daN m^{-3}),
W_b: Soil moisture content (%).
The draft power predicted from Equation 3 was rated to the field capacity (S) of plough. As a result, Equation 4 was obtained for predicting the specific energy requirement (E_S) of the mouldboard plough.

$$E_s = [[[(71.78) \cdot [[a \cdot P_b \cdot [(2.45) - [(0.71) / (a^3 \cdot P_b)] - [(0.14) / a]] + [(6.60) \cdot W_b] + (822.51)] / 10^3]] - (37.20)] \cdot a \cdot b \cdot n \cdot v^{1.5}] / [S / (3.60)] \quad (4)$$

In equation;
E_s: Specific energy requirement of mouldboard plough (MJ ha^{-1}),
a: Working depth (m),

P_b: Soil bulk density (daN m^{-3}),
W_b: Soil moisture content (%),
b: Working witdh (m),
n: Number of bottoms,
v: Forward speed (m s^{-1}),
S: Field capacity (ha h^{-1}).

To test the reliability of the developed prediction equations, the regression coefficients of relationships between the results from prediction equations and some results obtained by other researchers.

3.RESULTS AND DISCUSSION

The study showed that draft power and specific energy requirement could be successfully predicted by the prediction equations with good accuracy when working with cylindroid mouldboard ploughs in medium heavy soil condition. The regression coefficients of relationship between measured draft powers and predicted draft powers (Equation 3) of ploughs were varied from 0.948 to 0.996 (Table 1 and Table 2). The regression coefficient of relationship between measured and predicted (Equation 4) specific energy requirement of plough was 0.924 (Table 3).

Table 1. The relationships between the results from prediction Equation 3 and the results from field experiments

Type of plough	Forward speed[1] (m s^{-1})	Draft power[1] (kW)	Draft power[2] (kW)
Mouldboard plough	1.11	8.17	7.96
	1.67	13.92	14.76
Reversible mouldboard plough	1.10	8.16	7.46
	1.67	15.14	13.92
The regression coefficients (R^2)		0.948	

[1]From field experiment (Erol et al., 1996), [2]From prediction Equation 3.

Table 2. The relationships between the results from prediction Equation 3 and the results from field experiments

Forward speed (m s^{-1})	Draft power[1] (kW)	Draft power[2] (kW)
0.83	6.50	6.23
1.11	9.80	9.63
1.39	15.30	13.50
1.67	20.70	17.80
The regression coefficient (R^2)	0.996	

[1]From field experiment (Kheiralla et al., 2003), [2] From prediction Equation 3.

Table 3. The results from prediction Equation 4 and field experiments

Type of plough	Forward speed[1] (m s^{-1})	Field capasity[1] (ha h^{-1})	Specific energy[1] (MJ ha^{-1})	Specific energy[3] (MJ ha^{-1})
Mouldboard plough	1.11	0.255	115.34	112.39
	1.67	0.386	129.82	137.63
Reversible mouldboard plough	1.10	0.234	115.27	114.77
	1.67	0.354	141.16	141.55
The regression coefficients (R^2)			0.924	

[1]From field experiment (Erol et al., 1996), [2]From prediction Equation 3, [3]From prediction Equation 4.

It is thought that the specific energy requirement of the mouldboard plough can be predicted with great accuracy as regression coefficient of relationship between the measured and predicted draft power from Equation 3 was quite high.

4.CONCLUSION

As a result of this research, draft power and specific energy requirement cylindroid mouldboard ploughs could be successfully predicted by the prediction equations with good accuracy in medium heavy soil condition. The most important advantage of predicting the draft power and specific energy requiremet of mouldboard ploughs depending on technical properties of the plough, the physico-mechanical properties of the soil and the working conditions before the soil tillage will be useful in terms of energy saving.

REFERENCES

Bernacki, H., Haman, J. and Kanafojski, Cz., 1972. Agricultural Machines, Theory and Construction. US. Dept. of Commerce, National Technical Information Service, Virginia.

Boydaş, M. G. and Uygan, F., 2010. Kulaklı pullukta çeki kuvvetine etki eden faktörler. 26. Tarımsal Mekanizasyon Ulusal Kongresi: 22-23 Eylül, Hatay.

Dursun, İ., 2015. Toprak İşleme Alet ve Makinaları. Ankara Üniversitesi Basımevi, Ankara Üniversitesi Ziraat Fakültesi, Yayın No: 1618, Ders Kitabı: 570, Ankara.

Erol, M. A., Göknur Dursun, İ. and Dursun, E., 1996. Kaydırmalı Pulluk Geliştirilmesi. Tarım Orman ve Gıda Teknolojileri Araştırma Grubu, Proje No: TOAG-1044, Proje Sonuç Raporu, Ankara.

Göknur, İ., 1995. Kulaklı Pulluklarla Toprak İşlemede Koni İndeksine Bağlı Olarak Çeki Gücünün Tahmini İçin Bir Yöntem. Tarımsal Mekanizasyon 16. Ulusal Kongresi Bildiri Kitabı: 353-361, Bursa.

Göknur Dursun, İ. and Dursun, E., 2000. Orta ağır toprak koşulunda koni indeksi tahmin modelinin boyut analizi ile geliştirilmesi. Tarım Bilimleri Dergisi 6 (3): 37-41.

Kheiralla, A. F., Yahya, A., Zohadie, M. and Ishak, W., 2003. Modelling of power and energy requirements for tillage implements operating in Serdang sandy clay loam, Malaysia. Soil & Tillage Research 78(2004): 21-34.

TÜİK, 2018. Tarımsal Alet ve Makine Sayısı, 1998-2015. Retrieved in Mars, 29, 2018 from http://www.tuik.gov.tr/VeriBilgi.do?alt_id=1006.