Evaluation of tractor specific volumetric fuel consumption during harrowing in loamy-sand and clay-loam soils

Excel Ilaboya[1] Raymond Ekemube[1] • Ibinabo Ilaboya[2] David Bamigboye[2]

[1] University of Benin City, Agricultural Engineering, Nigeria

[2]Benson Idahosa University, Animal Science and Animal Technology, Nigeria

iilaboya@biu.edu.ng

Introduction

• Fuel is a major component of mechanised farm operational cost.

• Harrowing performance is influenced by soil resistance and tractor operating conditions.

• Specific volumetric fuel consumption (SVFC) provides an efficiency measure linked to fuel use

Objective

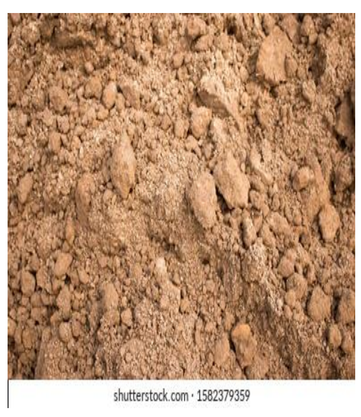
To evaluate the specific volumetric fuel consumption (SVFC) of a tractor during harrowing in loamy sand and clay loam soils at different operating depths and speeds.

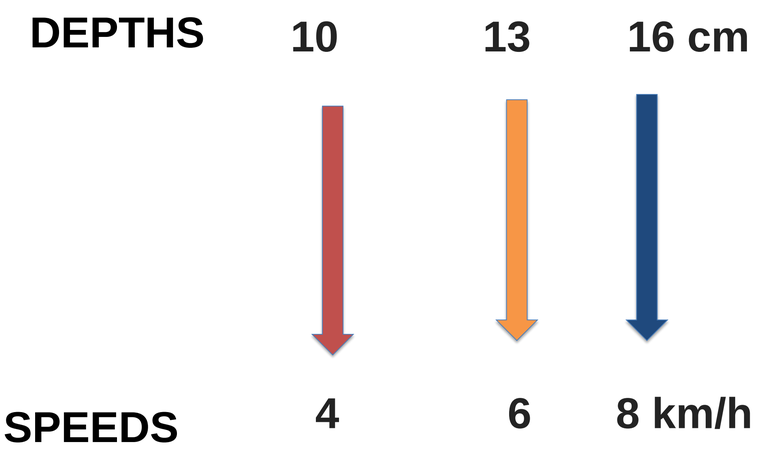
Materials and methods

Soil Types

Loamy sand

Clay loam





Lower resistance

Loamy sand imposed lower draught resistance and lower fuel demand.

Greater depth

Clay loam showed higher fuel consumption, particularly at greater depth.

Higher speed

SVFC decreased as forward speed increased.

Results

SVFC of Field Test during Harrowing Operation in Loamy Sand Soil

Depth, cm	Velocity, Km/h	FC, L/h	SVFC, L/kWh
10	4	2.92	0.72
10	6	4.09	0.62
10	8	4.19	0.44
13	4	4.26	0.81
13	6	5.96	0.69
13	8	6.1	0.49
16	4	6.42	0.99
16	6	8.97	0.85
16	8	9.18	0.60

SVFC: Specific volumetric fuel consumption

SVFC in loamy sand at 10 cm depth

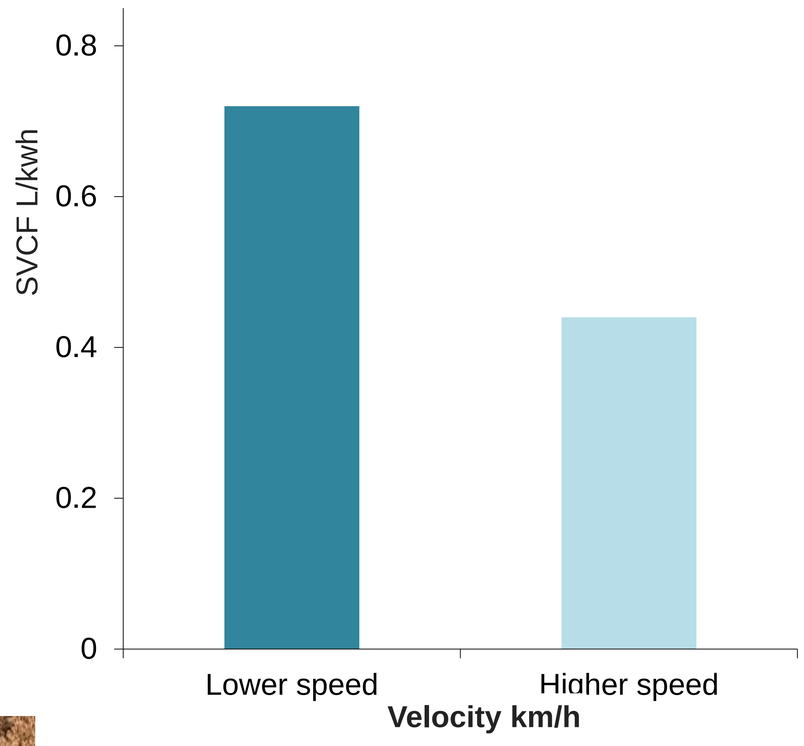


Fig 1. SVFC was lower at higher forward speed, of 8km/h.

SVFC of field test during harrowing operation in clay loam soil

Depth, cm	Velocity, Km/h	FC, L/h	SVFC, L/kWh
10	4	3.08	0.59
10	6	4.24	0.49
10	8	4.31	0.35
13	4	4.41	0.65
13	6	6.12	0.55
13	8	6.24	0.39
16	4	6.58	0.78
16	6	9.13	0.67
16	8	9.34	0.48

SVFC: Specific volumetric fuel consumption

Fig 2. SVFC was lower at higher forward speed, But showed higher fuel demand with increasing depth.

Heavy duty Harrowing machine

Conclusion

Fuel consumption during harrowing depends heavily on soil type and tractor settings, with lighter soils and higher forward speeds improving fuel efficiency to ultimately help reduce operating costs for small-scale agricultural production.