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Diesel Fuel Consumption During Field Operations

H. Mark Hanna
Iowa State University, hmhanna@iastate.edu

Dana D. Schweitzer
Iowa State University, schweitz@iastate.edu

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Abstract
Direct energy expenses (diesel, gasoline, propane, electricity) total more than $1 billion annually for Iowa's farmers. Farm management techniques such as adjusting tractor gear and throttle settings or reducing tillage depths can reduce diesel fuel consumption for row crop production. This study is being conducted over multiple years to measure the effects of energy management techniques on tractor fuel consumption during spring and fall field operations.

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Mark Hanna, extension ag engineer
Dana Schweitzer, program coordinator
Department of Agricultural and Biosystems Engineering

Introduction

Direct energy expenses (diesel, gasoline, propane, electricity) total more than $1 billion annually for Iowa's farmers. Farm management techniques such as adjusting tractor gear and throttle settings or reducing tillage depths can reduce diesel fuel consumption for row crop production. This study is being conducted over multiple years to measure the effects of energy management techniques on tractor fuel consumption during spring and fall field operations.

Materials and Methods

A small auxiliary 12-gallon fuel tank was mounted on a John Deere 7430 tractor. Plumbing was added for diesel fuel to be supplied and returned from the engine via either the main or auxiliary fuel tank, depending on the setting of a single flow control valve. A load cell under the auxiliary fuel tank measured the net (supply minus return) weight of fuel consumed.

Most fieldwork on the farm is conducted using small plot areas. One objective was to measure fuel consumption in areas of 0.7 to 1 acre when possible; the auxiliary tank measures fuel consumption within 0.1 lb increments. Another objective was to obtain multiple replications if land area and timing of trials allowed. Small plots or farm scheduling frequently conflicted with these objectives, limiting the ability to measure statistical significance beyond overall trends in data.

Fuel consumption was measured as gallons per acre (gal/acre). Although larger equipment consumes fuel at higher rates, fieldwork is completed at a faster rate (acres/hr). Gallons per acre generally remains consistent and is a common, useful measure for farmers.

Results and Discussion

Effects of shifting up one transmission gear and throttling back the engine's speed were compared during field cultivation in the spring (Table 1), stalk chopping (Table 2), and strip tillage (Table 3) in the fall. In all cases, shifting to a higher gear and reducing engine speed reduced fuel use while maintaining the same travel speed for field operations. Fuel savings ranged from 20 percent to 50 percent.

Conclusions

Results indicate reduced diesel fuel consumption when using a 'shift-up/throttle-back' strategy with drawbar loads that are less than the available maximum tractor horsepower. Loads operated by the power-take-off usually require operating the engine at rated PTO speed, however effective rotary cutting speed was able to be maintained during field conditions that were present. Results are only from the first year of study. Farm staff plans to continue further fuel consumption comparisons next year.

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Table 1. Field cultivation with different gear/engine speed combinations.

Operation	No. of replications	Treatment gear/engine rpm	Gal/acre
Field cultivation, 5 mph	3	C1/2080	0.80
	3	C2/1710	0.66
LSD $_{\alpha=0.05}$[a]			0.05

[a]Least significant difference between treatments at a 95% confidence level.

Table 2. Stalk chopping with different gear/engine speed combinations.

Operation	No. of replications	Treatment gear/engine rpm	Gal/acre
Stalk chopping, 5 mph	3	C1/2060	0.95
	3	C2/1750	0.64
LSD $_{\alpha=0.05}$[a]			0.06

[a]Least significant difference between treatments at a 95% confidence level.

Table 3. Strip tilling with different gear/engine speed combinations.

Operation	No. of replications	Treatment gear/engine rpm	Gal/acre
Strip till, 5.2 mph	3	C1/2170	2.10
	3	C2/1710	1.39
LSD $_{\alpha=0.05}$[a]			NS[b]

[a]Least significant difference between treatments at a 95% confidence level.