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Diesel Fuel Consumption during Field Operations

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Abstract
Direct energy expenses (diesel, gasoline, propane, electricity) total more than $1 billion annually for Iowa's farmers. Day-to-day 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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Diesel Fuel Consumption during Field Operations

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Introduction

Direct energy expenses (diesel, gasoline, propane, electricity) total more than $1 billion annually for Iowa's farmers. Day-to-day 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 6170R 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–return) weight of fuel consumed.

Most of the field work on the farm was 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/acre (gal/acre). Although larger equipment consumes fuel at higher rates, field work also is completed at a faster rate (acres/hr). Gallons/acre generally remains consistent and is a common, useful measure for farmers.

Results and Discussion

Effects of shifting up one or two transmission gears and throttling back the engine's speed were compared in the spring during field cultivation (Table 1) and in the fall during subsoiling/deep ripping (Table 2). In both cases, shifting to a higher gear and reducing the tractor's engine speed reduced fuel consumption while maintaining the same travel speed and tillage depth for field operations. Tractor fuel savings ranged from 15–30 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. Farm staff plan 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 mi/h	3	C1/2080	0.599
	3	C2/1720	0.405
LSD $_{\alpha=0.05}$[a]			NS[b]

[a]Least significant difference between treatments at a 95 percent confidence level.
[b]No significant difference at the 95 percent confidence level.

Table 2. Subsoiling with different gear/engine speed combinations.

Operation	No. of replications	Treatment gear/engine rpm	Gal/acre
Subsoiling, 3.7 mi/h	3	B1/2100	1.268
	3	B3/1500	1.066
LSD $_{\alpha=0.05}$[a]			NS[b]

[a]Least significant difference between treatments at a 95 percent confidence level.
[b]No significant difference at the 95 percent confidence level.