

# Farm Energy IQ



## Bearing Fruit with Energy Savings—Case Study

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Fuel used by tractors and other farm equipment represents the greatest energy expense for in-field tree fruit operations. This case study examines twelve fruit growing operations and compares fuel use in high density orchards to that in conventional medium density orchards. In this project, twelve growers received funding through an NRCS Conservation Innovation Grant (CIG) to establish one-acre high density orchard plantings of two apple varieties on dwarfing rootstocks. All participants followed Penn State protocol for site preparation, trellis construction, tree training, and general maintenance. Average fuel consumption and orchard production for the CIG blocks was compared to commercial fuel use and orchard production in medium density blocks. Fuel consumption was calculated using the *Orchard Block Fuel Use Calculator* developed by Penn State Extension.

## ORCHARD BLOCK FUEL USE CALCULATIONS

### STEP 1:

Compare block configurations (by filling in the gray boxes on the spreadsheet):

Conventional Style Layout Information	
Acres in Block	10
Area (ft <sup>2</sup> )	435,600
Row Length (ft)	1,000
Block Width	436
Row Spacing (ft)	20
Number of Tree Rows	20
Number of Alleys	19
Tree Spacing (ft)	16
Trees in Block	1,240

High Density Equivalent	
Row Spacing (ft)	14
Number of Tree Rows	30
Number of Alleys	29
Tree Spacing	4.5
Trees in Block	6,660

From this information, the program determines miles traveled during three common orchard operations:

Conventional System					
Orchard Operation	Passes	In Rows (ft)	Turning (ft)	Total Distance (ft)	Miles
Spraying	21	21,000	628	21,628	= 4.1
Mowing	40	40,000	1,257	41,257	= 7.8
Brush Mowing	21	21,000	628	21,628	= 4.1
High Density System					
Orchard Operation	Passes	In Rows (ft)	Turning (ft)	Total Distance (ft)	Miles
Spraying	31	31,000	660	31,660	= 6
Mowing	31	31,000	660	31,660	= 6
Brush Mowing	31	31,000	660	31,660	= 6

**STEP 2:**

Select the tractor and implements (from drop-down menus) used for the three orchard operations.

<b>Sprayer</b>	<b>Conventional</b>	<b>High Density</b>
<b>Tractor</b>	Tractor A	Tractor C
<b>Sprayer Type</b>	Engine Driven	PTO Driven
<b>Sprayer Fuel Consumption (Gal/hr)</b>	4.5	3.4
<b>Speed (MPH)</b>	3	3
<b>Hours in Field</b>	1.4	2
<b>Fuel Used (Gal)</b>	13.1	6.8
<b>Times Per Year</b>	12	12
<b>Fuel Used Per Year</b>	157.3	81.5
<b>Mower</b>		
<b>Tractor</b>	Tractor A	Tractor C
<b>Speed (MPH)</b>	3	3
<b>Hours in Field</b>	2.6	2
<b>Fuel Used (Gallons)</b>	13.3	6.8
<b>Times Per Year</b>	6	6
<b>Fuel Used Per Year</b>	79.7	40.8
<b>Brush Mower</b>		
<b>Tractor</b>	Tractor A	Tractor C
<b>Speed (MPH)</b>	3	3
<b>Hours in Field</b>	1.4	2
<b>Fuel Used (Gal)</b>	7	6.8
<b>Times Per Year</b>	1	1
<b>Fuel Used Per Year</b>	7	6.8

Tractor speed and times per year were entered for each orchard operation, and the calculator determined the annual fuel consumption for each operation.

### STEP 3

Enter the current price of fuel. The calculator demonstrates that although the miles traveled are greater in the high density system, the smaller equipment results in about half the fuel costs per acre and a 71% decrease in fuel cost per bushel—from \$0.21 per bushel for medium density blocks to \$0.06 per bushel for high density plantings.

<b>Price of Diesel</b>	\$4.25
<b>Single Block</b>	
<b>Conventional</b>	
Gallons Per Year	244
Cost Per Year	\$1,036.83
Cost Per Bushel (500 bu/acre)	\$0.21
<b>High-Density</b>	
Gallons Per Year	129.1
Cost Per Year	\$548.75
Cost Per Bushel (900 bu/acre)	\$0.06

Fuel use is difficult for orchardists to predict, especially when considering new planting systems or management schedules. To predict the economic impact of orchard design decisions on growing operations, download the Penn State Extension *Orchard Fuel Use Spreadsheet* from: <http://extension.psu.edu/plants/tree-fruit/commercial-tree-fruit-production/energy-efficiency/fuel-consumption-calculator/view>.

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