

## Where Should You Invest to Improve the Capacity of Your Harvesting System?

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Questions are sometimes raised about whether mowing or chopping is the more limiting operation in a haylage harvesting system. Mowing equipment, windrow mergers, and choppers all come in a range of widths with self-propelled machines that can be quite a bit more expensive than pull-type versions. This article looks at how to compare costs of operating different sizes of equipment with the ultimate goal of identifying the cheapest way to maximize the system's overall capacity.

Things to consider in a capacity analysis are:

- Acres to be harvested,
- Days available for the harvest,
- Hours of optimal working time/day,
- Labor available and its cost,
- Harvesting equipment already on hand and its condition, and
- Availability of capital for replacing worn-out machines and purchasing additional items.

An analysis of harvesting capacity could begin with an inventory of the equipment on hand and a list of items being considered for purchase. When you have your list in mind, calculate the capacity of each implement:

$$\text{acres/hour} = \frac{\text{swath width (in feet)} \times \text{operating speed (miles/hour)} \times \text{field efficiency (to account for turning time)}}{8.25}$$

This analysis might identify bottlenecks where some implement sizes do not permit the harvest to be completed in the days available with the available labor force. Perhaps adding a second implement of the same size might get the job done, so a possible next step in the analysis might be to compare costs and labor requirements for the two smaller items vs. one larger one. If a second driver and tractor are not available, that may eliminate the doubling-up option. Another question at this point would be whether tractors and labor are available to both mow and chop at the same time. If both can not be done at the same time, can they be done sequentially in the time available? If the answers to both questions is "no", the alternatives may be: 1) increase capacity of the mowing equipment, 2) increase capacity of the chopping equipment, or 3) add an operator and/or tractor so that both operations can be done at the same time.

The next step is to calculate the ownership and operating costs for each operation. The table below was calculated using the MACHDATA.XLS spreadsheet I use for my

machinery cost extension publication. The costs have been recalculated, however, to look specifically at an example situation with 200 acres of a hay crop that is harvested in three cuttings, covering 600 acres total. I've also assumed that the forage harvesters will also be used on 200 acres of corn silage, as well, so only a portion of the ownership costs are charged to the hay crop. If making four cuttings/year, the cost/cutting would be a few percent lower since the annual equipment ownership costs are spread over more acres.

I've looked at whether the mowing or the chopping operation is the more limiting operation, for six different equipment combinations:

- 1) 9-foot mower-conditioner and pull-type forage harvester taking one swath/pass,
- 2) 12-foot mower-conditioner with the same pull-type chopper taking one swath/pass,
- 3) 12-foot mower-conditioner with a self-propelled chopper (I've assumed that the self-propelled unit travels a little faster),
- 4) 14-foot mower-conditioner with the self-propelled chopper
- 5) 9-foot mower-conditioner and a windrow merger, which allows the pull-type chopper to cover two swaths or 18 feet/pass, and
- 6) the same 9-foot mower-conditioner and windrow merger, but with the self-propelled chopper.

Obviously, there are many other combinations that could be compared.

Weather conditions and labor availability are assumed to permit mowing four hours/day and chopping six hours/day. The fourth column of the table shows that the chopping operation limits capacity in the first two scenarios. The self-propelled chopper has enough additional capacity to keep up with mowing in the last four scenarios.

Economists often analyze tradeoffs visually by means of "efficient frontier" graphs. The graph below compares the days required per cutting (horizontal axis) with the total machinery ownership and operating costs per year (vertical axis). Under the assumptions I've made, the cheapest system is the 12-foot mower-conditioner with the pull-type chopper. It will cost \$5,254/cutting/year to operate and will take ten days to do the job. Going to a 14-foot system with a self-propelled chopper will cut the time to seven days, but bumps the cost up to \$6,861/year. One might think that the nine-foot system would be the cheapest; however, the extra labor adds to the cost for that smaller size.

How significant is the ability to get all alfalfa acres put up in seven days instead of 13 days? Reduced risk of rain damage and more acres harvested at optimum maturity/quality would be advantages of the larger equipment that are not reflected in these costs. In spring, the agronomists expect standing alfalfa to lose 4 RFV units per day on average. Within a normal RFV range (excluding really high and really low test results), an additional RFV unit is worth around \$0.90 per ton. Thus, if you lose 4 RFV units per day you don't get the field cut, theoretically you can lose \$3.60 per ton per acre per day.

The bottom line is that thinking in terms of tradeoffs, pushing a pencil, and considering slightly "outside-the-box" equipment combinations may help you identify cost-cutting and revenue-enhancing opportunities.



Time Requirements and Costs Per Cutting for Selected Haylage Mowing and Chopping Equipment Combinations to Harvest 200 Acres of Haylage, Three Cuttings\*

Equipment	Swath, ft.	Cost /acre	Cost /Cutting /Year	Acres /hour	Feasible acres/day	Days to complete limiting operation
Mower-Conditioner 9 Ft	9	\$8.37	\$1,675	4.36	17.5	
Forage Harvester (Pickup Head) 9 Ft	9	\$22.06	\$4,412	2.48	14.9	
Total Cost and Days Required for Limiting Operation		\$30.43	\$6,087		14.9	13
Hay Swather-Cond 12 Ft	12	\$8.39	\$1,679	5.82	23.3	
Forage Harvester (Pickup Head) 12 Ft	12	\$17.88	\$3,575	3.31	19.9	
Total Cost and Days Required for Limiting Operation		\$26.27	\$5,254		19.9	10
Hay Swather-Cond 12 Ft	12	\$8.39	\$1,679	5.82	23.3	
Pickup Head for SP Harvstr Base 12 Ft	12	\$29.02	\$5,804	4.07	24.4	
Total Cost and Days Required for Limiting Operation		\$37.41	\$7,483		23.3	9
Hay Swather-Cond 14 Ft	14	\$8.71	\$1,741	6.79	27.2	
Pickup Head for SP Harvstr Base 14 Ft	14	\$25.60	\$5,120	4.75	28.5	
Total Cost and Days Required for Limiting Operation		\$34.31	\$6,861		27.2	7
Mower-Conditioner 9 Ft	9	\$8.37	\$1,675	4.36	17.5	
Hay Merger 9 Ft	9	\$7.81	\$1,562	6.11	36.7	
Forage Harvester (Pickup Head) 18 Ft	9	\$13.80	\$2,761	4.96	29.8	
Total Cost and Days Required for Limiting Operation		\$29.99	\$5,998		17.5	11
Mower-Conditioner 9 Ft	9	\$8.37	\$1,675	4.36	17.5	
Hay Merger 9 Ft	9	\$7.81	\$1,562	6.11	36.7	
Pickup Head for SP Harvstr Base 18 Ft	9	\$21.09	\$4,217	6.11	36.7	
Total Cost and Days Required for Limiting Operation		\$37.27	\$7,454		17.5	11

\*If making four cuttings/year, the cost/cutting would be a few percent lower since the annual equipment ownership costs are spread over more acres.

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