Apple Harvest Platforms: Quantifying Efficiency and Determining Economic Benefits

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Today, many NY apple farms have a portion of their farm planted to high-density systems, and increasingly, most new plantings are high-density. These high-density systems have more than 1,200 trees/acre and are grown in the tall spindle format or another form of a "fruiting" wall system. The primary reasons to plant these types of systems are to return the investment quickly and to increase the rate of return by way of high early yields, greater cumulative yields over the life of the investment and improved fruit quality.

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With increased tree density and more precocious dwarfing rootstocks comes trellis systems, tree training, and increased labor costs compared with low density free standing systems. However, many farms have purchased or made platforms to improve the labor efficiency of tasks like pruning, hand thinning, trellising and tree training (Miranda Sazo et al. 2010). Today's modern high-density systems lend themselves to platforms or mechanization, due to narrow canopies and a more uniform production or work area, not only from the bottom to the top of the tree but from tree to tree.

Platforms improve efficiencies, primarily by eliminating ladder work. Workers are positioned at various heights on a platform and positioned to reach the work area while standing in place. Another key benefit to platforms is that a "steady" pace can be established that creates a more constant and efficient work flow. Lastly, after using platforms, most employees do not want to go back to using ladders, as they experience less fatigue from working on a platform and more work is accomplished.

Up until a few years ago, platforms were used exclusively for dormant pruning and growing season tasks, but not for harvest. However, there are now several commercial platforms available that can accommodate harvest and there are a small number of NY growers using them. This project was designed to investigate and trial commercial platforms during the western NY harvests of 2015 and 2016, to determine the potential efficiency gains and economic benefits.

Methods

Platform efficiency trials were conducted at four farms during the 2015 and 2016 seasons using three commercial harvest platforms (Figures 1–3). At each trial, a platform was compared with the traditional picking method for each farm. To ensure comparable picking scenarios for the two methods, orchards were chosen that were uniform (variety, spacing, age, yield), the same pickers were used for both methods, and the trial duration was the same. The key metric that was used to compare efficiency was bushels per man-hour. As an example, if a six-person team picked 50 twenty-bushel bins in eight hours, their picking rate would be 20.8 bushels per man-hour (50 bins x 20 bushels ÷ 6 pickers ÷ 8 hours). To establish this metric, the trials were timed to the minute (excluding breaks) and the bins were counted to the bushel.

In 2015, three trials were conducted, and in each case the apple quality on the trees was good enough to strip pick or one-pick the orchards. In 2016, the plan was to conduct trials in which the orchards were spot or multi-picked. From speaking with growers who had platform experience, the efficiency gains are much higher when spot picking. Spot picking with the traditional method using ladders has more inefficient ladder use, hence better efficiencies result when using platforms. Unfortunately, due to the challenging growing season in 2016, we were unable to conduct a spot pick trial, but conducted additional one-pick trials similar to 2015.

Platform Types and Features

The purpose of the trials was to determine if platforms increased picking efficiency. There was no objective to determine which platforms were the "best" or to recommend a specific platform to the industry based on the results. The three chosen for the trials were simply available and in use on local farms. There are several commercial platforms available in the marketplace, having some differences in functionality and features. The following is a list of major harvest platform functions and features:

Picking Zone: The picking zone is the area that is picked from the platform. There are two types that include "top-only" and "bottom to top". In the case of top-only, the picking crew typically picks the bottoms first, from the ground and without a platform. After the bottoms are picked, a team on the harvest platform will finish by picking the tops. Note that for very narrow canopies, the pickers can pick both sides of the tree and the platform would progress through the orchard in every other

Figure 1. Revo Piuma platform

Figure 2. Automated Ag Systems platform

row. For deeper/wider canopies, pickers will pick to the center of the tree and the platform would progress through the orchard in every row. The maximum row spacing for most platforms is 13–14 feet, depending on canopy structure.

Bin Flow: Bin flow describes how the bin is placed in the orchard and how it is utilized by the platform. "Flow through" platforms require bins placed in the row and in front of the advancing platform. The bins are picked up/conveyed into the platform, they are filled and the bins exit out of the rear of the machine and onto the ground. "Bin exchange" platforms typically have trailers that are filled with bins behind the machine and the platform pulls bins from the trailers and deposits the filled bins on to the ground.

Bin Fill: Bin fill simply refers to how the bins are filled. "Picker filled" means the picker directly deposits the apples into the bins just as is done for traditional picking. The other style uses a "bin filler", similar to what can be found in packing sheds. Apples are placed on a conveyor (belt or suction tube) and the apples flow to a bin filler

Drive: Most platforms are self-propelled using low horsepower engines and hydraulic pumps.

Steering: There are two types: "auto steering" or "manual steering" by the picking team.

Table 1 lists the commercial platforms that were used in the trials and their major functions and features.

Platform Efficiency Results

There were three trials conducted in 2015 and two in 2016. Three of the five trials showed efficiency gains of 13–16.8%, while two trials in 2015 showed no efficiency gains. It should be noted that the trials with efficiency gains had pickers with experience using the machines and working as a team. With the two trials that demonstrated no gains, the pickers had very little prior experience on the platforms. A key finding from the trials was that it takes time for the pickers to become familiar with the platform and, more importantly, learn to work effectively as a team. It could take several days for a team to learn to work well as a unit and to maximize their picking efficiency.

Figure 3. Huron Systems platform

Economic Analysis Results

[***NOTE:*** *The following results are based on trial results and hypothetical farm operations and practices. Due to a large number of variables that may be different from farm to farm, a tool has been developed to assist farm operations with calculating the potential savings for their own operations. This customizable tool to evaluate potential returns from investing in harvest platforms is available on the Lake Ontario Fruit Program website (lof.cce.cornell.edu).*]

Based on the timed trials, we conducted an economic analysis assuming an efficiency increase for harvest activities of 13%. Since the platforms have applications in non-harvest activities as well, we assumed a 30% labor efficiency increase in pruning and a 40% increase in hand thinning (Miranda Sazo et al. 2010). Our calculations used an hourly wage (plus employer taxes) of $14.80, based on the average wage from the Cornell Fruit Farm Business Summary. Our model also worked with the assumption that there are 16 weeks available per season to prune, 8 weeks available to hand thin, and 8.5 weeks available to harvest.

Based on our model, a 150-acre farm purchasing one platform would save nearly $43,000 annually while completing 100% of its pruning, 100% of its thinning, and 27% of its harvest activi-

ties with platform equipped teams (Table 2). This translates into a payback period of around 1.5 years for a $65,000 platform at sticker price (Table 3). A 300-acre farm purchasing 3 platforms would save $91,348 a year, with a payback period of 2.1 years. They would complete 100% of their pruning requirements, 100% of their thinning requirements as well as about 41% of their harvest needs.

Table 1. Commercial Platforms Used in Efficiency Trials and Major Features.

Platform	Picking Zone	Bin Flow	Bin Fill	Drive and Steering
Huron Systems	Bottom to Top	5 Bin Exchange	5 Bins – Picker Fill	Self-propelled and manual steering
REVO Piuma	Top Only	Flow Through	1 Bin - Pick to Conveyor w/Bin Filler	Self-propelled and auto steering
Automated Ag Systems	Top Only	Flow Through	1 Bin – Picker Fill	Self-propelled and auto steering

The majority of savings come from the purchase of the first platform. Subsequent platforms bring with them additional savings, but because the first one or two platforms are often enough to cover thinning and pruning needs, the additional savings come exclusively from harvest labor savings. For example, a 150-acre farm saves $42,822 annually with its first platform, an additional $5,583 with its second and third platforms, and then only an additional $3,454 if it were to purchase a fourth platform. These progressively lower additional savings result in longer payback periods for purchases involving more than one or two platforms (Figure 4).

Purchasing a platform exclusively for harvest generates labor savings, but has a long payback period, due to the lower efficiency gains versus other platform activities and the fact that it is only utilized for 8–9 weeks per season. As mentioned, no trials were conducted for spot picking but it is estimated that efficiencies would be in the range of 25–50%. As a hypothetical scenario, if a platform was used on 50% of the acreage for one pick and 50% of the acreage for spot picking, the annual savings could range from $18,000 to $43,000 per year with a 1.5–3.6 year payback range. Another way to pay for the investment more quickly would be to use the harvest platform over two shifts, which has been successfully tried by some growers. Two shifts doubles the hours and number of pickers using the machine in a season, thereby increasing the savings and reducing the payback period.

Table 2. Annual Wage Savings by Farm Acreage and Platforms Purchased.

	Acres		
Platforms	50	150	300
1	$18,016	$42,882	$57,041
3	$19,168	$54,049	$91,348
5	Not needed	$57,503	$102,515
7	Not needed	Not Needed	$113,682

Table 3. Years Required to Payback Platform Investment by Acreage and Platforms Purchased.

	Acres		
Platforms	50	150	300
1	3.6	1.5	1.1
3	10.2	3.6	2.1
5	Not needed	5.7	3.2
7	Not needed	Not needed	4.0

Discussion

More platforms are required for harvest than pruning, thinning and other seasonal tasks. The economic analysis indicated high returns from seasonal tasks that in theory could cover the costs of purchasing additional platforms for full harvest coverage. However, these additional platform purchases by themselves have a longer payback period. From this perspective, additional factors may be needed to justify the additional investment, especially for more leveraged operations. Farms with a portion of their farm requiring spot picking would see much improved savings or payback. There may also be benefits to spot picking more often in varieties like Honeycrisp. Some farms may see additional returns from platforms if they are able to do second-shift picking,

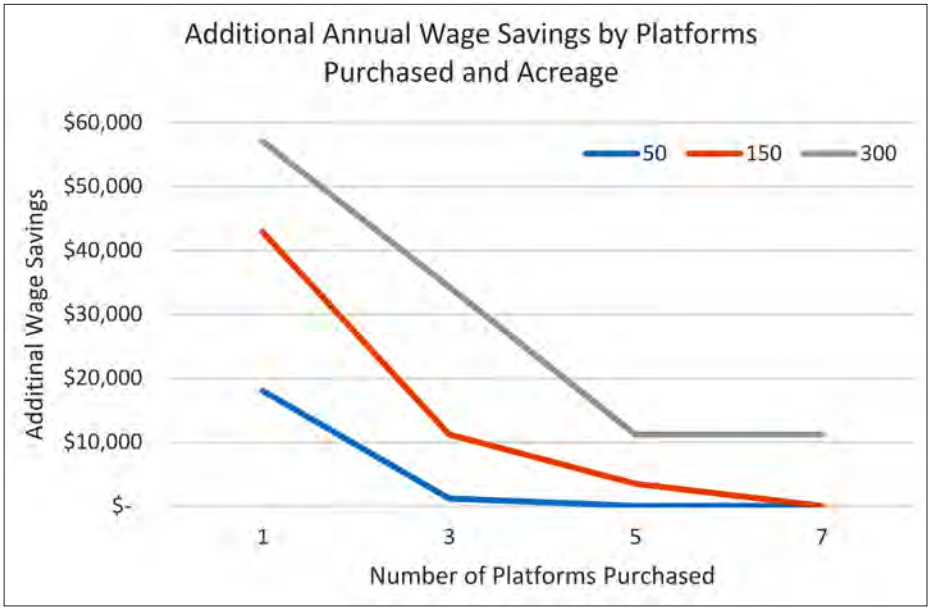

Figure 4. Additional annual wage savings by platforms purchased and acreage.

which would allow for more use of the platform and a quicker repayment period. Lower injury rates such as decreased falls from ladders could have large benefits for farms and farmworkers.

Some of the benefits might be considered less tangible, but are by no means less important. "Getting the job done" on time is something that can have a variety of benefits for a business. Satisfied workers can decrease labor turnover as well as improve recruitment. Harvest platforms may increase the pool of workers available to apple farms, as platforms are less physically demanding than ladders. These benefits can impact a farm's bottom line and are an interesting topic for future research, especially as labor markets become tighter and costs continue to increase under NY's new minimum wage legislation.

Conclusions

For farm operations that do not own a platform yet have a portion of the farm with row spacings at 14' or less and intend to plant high-density orchards in the future, there is a quick payback when platforms are used for pruning (dormant/summer), hand thinning, tree training and trellising. If the vision for the farm is to have narrower systems (<13') grown in a fruiting wall format, a platform that can accommodate harvest should be considered, as it will improve the payback on the investment and provide other operational and human resource benefits.

Our analysis indicates that most farms growing high-density systems should at a minimum evaluate their options for using harvest platforms. While the payoff may be lower than for pruning and thinning, there may be additional gains beyond labor efficiency. Given the importance of managing labor costs and supply in the current labor market and policy environment, the use of harvest platforms is one strategy to consider for remaining competitive in a global marketplace.

Literature Cited

Miranda Sazo, M., DeMaree, A., and Robinson, T. 2010. The Platform Factor – Labor Positioning Machines Producing Good Results for NY Apple Industry. NY Fruit Quarterly 18(2): 5–9.

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