

FINAL REPORT

Project Title: Developing Efficient Work Platforms
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OBJECTIVES:

1. Determine the economic benefits of employing mechanical assist machines that reduce pruning, thinning, pheromone placement costs, and evaluate harvest efficiency in peach and cherry orchards.
2. Determine the economic benefits of employing platforms that reduce pruning, thinning, and pheromone placement in apple orchards.
3. Measure efficiencies of mechanical assisted harvest machine and platforms vs. orchard ladders and express those findings in labor per hour, bins, boxes, and pounds of fruit sold.
4. Facilitate L&I acceptance of equipment, ergonomics and safety components.
5. Assessment of worker, crew and management dynamics.

SIGNIFICANT FINDINGS:

- Efficiency and productivity of blossom thinning, green fruit thinning, limb tying, tree training, summer pruning and dormant pruning increases with the use of continuous creep, auto-steer, semi autonomous platforms.
- Degree of gained efficiency and productivity is task, orchard system and management dependent.
- Tasks that require the greatest number of ladder sets will yield the greatest efficiency gains with the platform.
- Growers want to overstaff the platforms. Limiting motion and work area per worker will negatively impact productivity.
- Uniform fruiting walls are the ideal system for platform work.
- Orchard acres adaptable to current commercial platforms are limited.
- Number of machines required to cover acreage for time sensitive tasks (thinning) will be a factor in adoption by industry.
- Machines that have built-in flexibility to physically fit into multiple planting systems and tasks should be the commercialization goal.
- All workers interviewed prefer the platform to the ladder if they can sustain hourly pay / daily pay.
- When working on a platform overall fatigue was reported to be reduced however there are situations when fatigue is a limiting factor (working above shoulder height when pruning with electric/pneumatic equipment, traveling at high speeds when pruning with loppers).
- Repetitive motion and impacts will need to be fully evaluated and mitigated.

PROGRESS SINCE 3RD QUARTER:

- 1) Harvest data was limited to 5 days of Pink Lady harvest using the Argilese AF-5. Productivity using the platform did not equal that of the ladder, although the conditions of the test were less than favorable.
- 2) Dormant pruning was conducted using the Blueline Jr. and Peterson machine at 6 orchards. Productivity was calculated on both ladders and the platform. Data was collected in linear feet per minute. Across the 6 orchards, pay scales, systems and crews, the efficiency gained with the use of platforms ranged from 30-50%.
- 3) Electrocoup (electric / battery-operated clippers) were evaluated during dormant pruning. Data was collected using linear feet/minute and cuts/minute protocol. Efficiencies gained/lost varied across crews and systems. Overall, the equipment was not fast enough for the employees and they choose loppers over the electrics.
- 4) The University of Washington – PNASH/Occupational Health Group, collected ergonomic (time and motion) data during harvest (ladders only) and during pruning (ladders and platform). This data is considered baseline and was reported in the centers NIOSH grant. The grant is currently under review.
- 5) Pneumatic assist pruning was attempted with Blueline Jr. – diesel engine ring failed during operations with 4 pneumatic hand prunners. Have recommended to Blueline that Jr. platforms have 4 cylinder engines (instead of two) and gear reduction wheel motors.
- 6) Built a self-powered, air compressor trailer that can be towed by the Blueline Jr. The trailer provides 24 ft³/min at 175psi of oiled air for up to six tools.
- 7) Imported 3 types of pneumatic cutting tools to evaluate. Test is ongoing. Maintainable cut speed seems to be good ~50 –60 cuts/min. But each of the 3 types of cutting tool is cutting about 40% under manufacture specifications (1.2 inch) making commercial use nonviable without going to 240 to 250 psi line pressure (ongoing).
- 8) Built self-powered handgun spray trailer for the Peterson and Blueline Jr. platforms. This sprayer will be used for experimental handgun apogee applications, 2nd quarter 2006.

Fig. 1

Productivity Gained with Platforms

Time required to complete a set task (string/minute, trees/minute, etc.) when working on a platform and when working on a ladder. The data below is a composite of all data collected. Data was collected in two dimensional, fruiting wall (angled and vertical) pear and apple systems.

Task on Platform	Productivity compared to Task on Ladder
Harvest	-10%
Dormant Pruning	+30 -50%
Tree Training	+55%
Top String Tying	+67%
Green Fruit Thinning	+19%
Summer Pruning	+30-40%

FACTORS THAT IMPACT PRODUCTIVITY:

- 1) Number of employees on the platform
 - Not enough work in front of the worker
 - Not enough “elbow room” per worker – space constraints
- 2) Uniformity of fruiting wall
 - Down time when trees or targets (fruit/blossoms/limbs) are missing
- 3) Crew dynamics
 - Leadership, authority, gender/age/ability/motivation mix
 - Lack of buy-in by one or more employee
- 4) Speed of platform movement
 - Too slow and/or too fast for the specific task
- 5) Management style
- 6) Productivity expectations (output/quality)
- 7) Pay rate/scale/method
- 8) Task (thinning vs. pruning etc.)