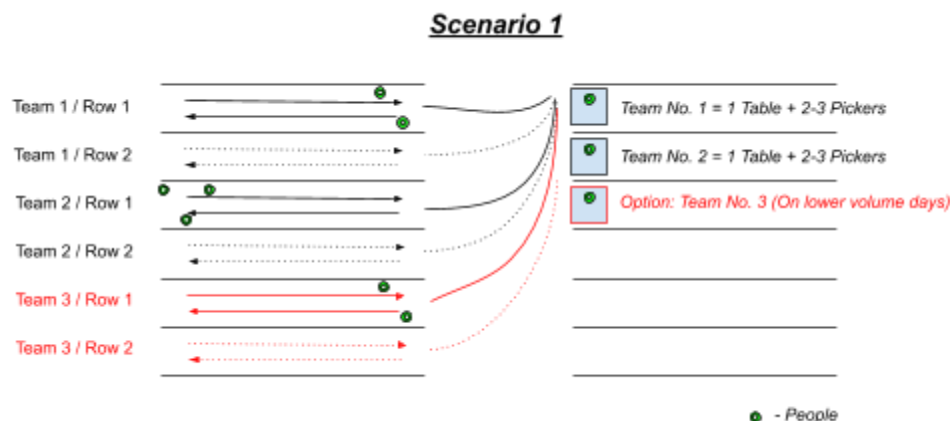


How to Maximize Crew gains with Burros

- Field conditions for best performance:
 - Mowed centers and minimal water/mud in the row center
 - Canes cut (Chest high or above)
 - Note: Burro artificial intelligence is continually improving, but reducing the “false obstacles” listed above will increase Burro’s speed in the field and reduce slowing/stopping.*
- Crew advice for optimal gains:
 - Keep Burro moving - any time pickers have a full tub, they should send it back to the pack table with Burro (objective is to keep the packers packing, and pickers picking, with a continuous flow of fruit coming out of the field).
 - Burro stops for wheelbarrows. As Burro approaches, if there are other pickers behind them in the row, pickers should move wheelbarrows to the side (such that Burro can pass by them)
 - Don’t overfill tubs (To prevent fruit from falling out)
 - Packers should be instructed to always send Burros into the field with empty pick tubs.
 - The easiest, simplest way to match pickers tubs to their respective packers is to place leaves in the tubs (i.e. Team 1 = 1-Leaf, Team 2 = 2, etc.)
- Burro specifications:
 - Burro carries 6 field tubs; if crews are picking more than 6-Tubs per Burro trip, run Burro faster.
 - Recommended Speed: 0.8m/s to 1.2m/s
 - Burro’s return speed is 70% slower than go-in-speed to avoid jostling grapes.
 - Burros can be trained from pack table to rows in <1 minute (for quick set up/reconfiguration)
 - Burro Records:
 - Max pick tubs carried / hour over 8 hour day: 46 (~1400 lbs/hour). Can you beat this?
 - Max utilization (time in motion vs. time stopped): 46%
 - Max average speed over course of day: 2.4 MPH (1.1 m/s - Not advised to exceed 1.2m/s)
 - Max distance in day of crew use: 7.4 Miles
- Advised & optional layouts are shown below.
 - We believe that Scenario 1, shown below, is the best use case. All scenarios can be altered with more people per row, depending on crop load and packer speeds.
- We are here to support you with anything Burro-related (problems/support, training, etc.)

Scenario 1: Full Row Pick/Pack with Burro (Optimal Scenario for Burro)



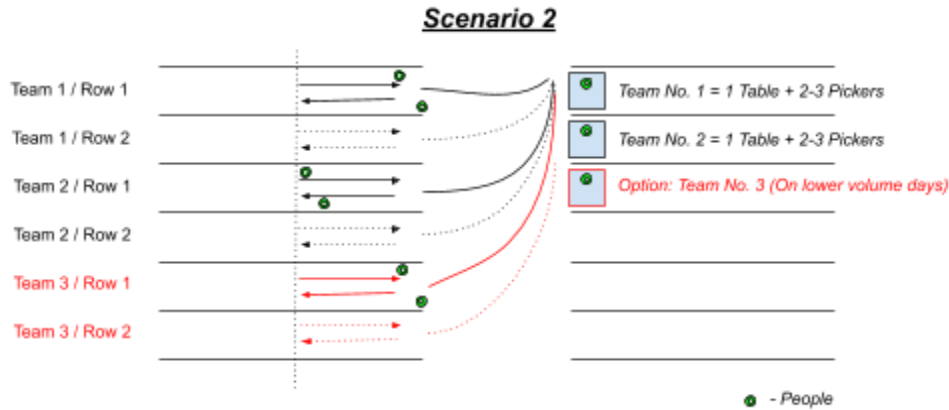
1. Full Row Pick
 - a. 3-4 People dedicated to each 600Ft long Row.
 - i. Picker/Packer Team: 1-Packer + 2-3 Pickers
 - b. Locate Pack Tables across the avenue. (Allowing space for Burro to navigate between rows.)
 - c. Running full rows reduces pack table moves and crew movement (only Burros move).
2. Advising a 4-Row Pattern.
 - a. 1-Burro services 2-Picker/Packer Teams:
 - i. Each Picker/Packer Team is responsible for 2-Rows.
 - ii. As each Team clears their Row 1, they move to Row 2 in their pattern.
 - iii. Once the 4-Rows are cleared in total, the Pack Table moves to the next set of 4-Rows.
 - iv. Pick/Pack Team 1 starts at the near end of the field, while Pick/Pack Team 2 - Starts at the far end of the field (making a round trip as quick as possible).
 - b. Burro takes 5-7 minutes per single row round trip - in/out of a full row (including load/unload time with crews).
 - c. In testing with the California Table Grape Commission, we've observed that an 8 to 10 person crew using a single Burro and harvesting this way, picks/packs 43% more fruit each day.

Burro Metrics - Scenario 1 (2 Teams @ 2 Rows)			
Distance / Row Trip (to pack station)			
Row Length (Average run/row)	600 ft.		
# of rows covered	2		
Average distance from row end to pack station	25		
Stop delays (load/unload):			
Pickers/row	2		
Time/stop (mins)	1		
Packer stops per run	1		
Minutes Stopped / round trip	6		
Idle Time / Run	46%		
Time in Motion / Run	54%		
Crew Size			
Pickers	4		
Packers	2		
People per Burro	6		
Burro Run Speed			
Average MPH	2		
M/S	1.0		
Time Burro passes between pickers			
Average (minutes)	13.0		
Runs/day			
Hours/day	8		
Runs/day	36.6		
Distance/day @ Average	8.7		
		Burro Metrics	
		Burro	Burro Distance
		Weight	Per Day
Picker productivity (field tubs/hour)	Robot Average Totes/Run	Per Day	Average
3	1.3	2,880	8.67 miles
4	1.7	3,840	

5	2.2	4,800
6	2.6	5,760
8	3.5	7,680
10	4.4	9,600
12	5.2	11,520
14	6.1	13,440

- d. When pick volume/tempo allows, Picker/Packer Teams can be added
- e. This video shows this style use in production setting: <https://youtu.be/zRMBUErhpeA>

Scenario 2 - Half Row Pick/Pack with Burro



1. Half Row Pick
 - a. 3-4 People dedicated to each 300Ft long Row.
 - i. Picker/Packer Team: 1-Packer + 2-3 Pickers
 - b. Locate Pack Tables across the avenue. (Allowing space for Burro to navigate between rows.)
2. Advising a 4-Row Pattern.
 - a. 1-Burro services 2-Picker/Packer Teams:
 - i. Each Picker/Packer Team is responsible for 2-Rows.
 - ii. Once the 4-Rows are cleared in total, the Pack Table moves across the avenue, or to the next set of 4-Rows.
 - iii. Pick/Pack Team 1 starts at the near end of the field, while Pick/Pack Team 2 - Starts at the far end of the field (making a round trip as quick as possible).
 - b. Burro takes 3-5 minutes per single row round trip - in/out of a half row (including load/unload time).
 - c. When pick volume/tempo allows, Picker/Packer Teams can be added.

Burro Metrics - Scenario 2 (3 Teams @ 3 rows)	
Distance / Row Trip (to pack station)	
Row Length (Average run/row)	300 ft.
# of rows covered	3
Average distance from row end to pack station	25
Stop delays (load/unload):	
Pickers/row	2

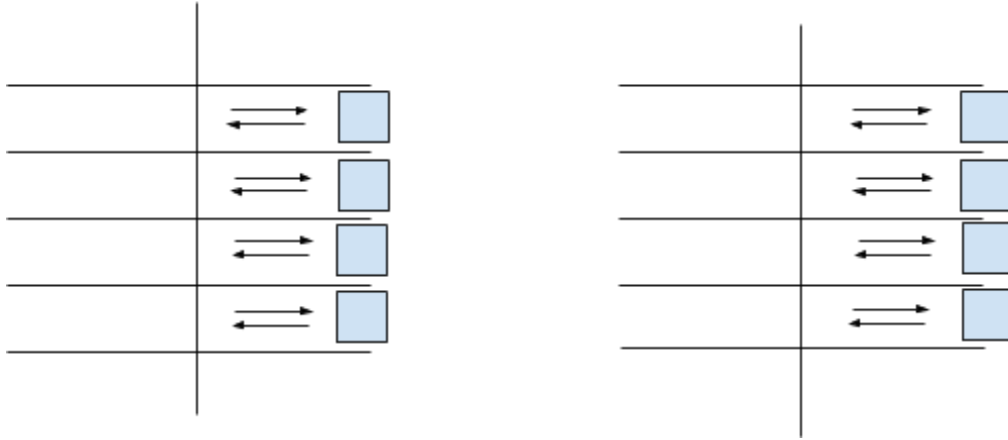


Time/stop (mins)	1		
Packer stops per run	1		
Minutes Stopped / round trip	9		
Idle Time / Run	62%		
Time in Motion / Run	38%		
Crew Size			
Pickers	6		
Packers	3		
People per Burro	9		
Burro Run Speed			
Average MPH	2		
M/S	0.9		
Time Burro passes between pickers			
Average (minutes)	14.5		
Runs/day			
Hours/day	8		
Runs/day	33.0		
Distance/day @ Average	6.1		
		Burro Metrics	
		Burro	Burro Distance
		Weight	Per Day
Picker productivity (field tubs/hour)	Robot Average Totes/Run	Per Day	Average
3	1.5	4,320	6.10 miles
4	1.9	5,760	
5	2.4	7,200	
6	2.9	8,640	
8	3.9	11,520	
10	4.8	14,400	
12	5.8	17,280	
14	6.8	20,160	

Scenario 3: Existing Pick/Pack Method

1. Pack tables at row ends
2. Blocks divided into halves / picking stops at the halfway mark.
3. If incorporating Burro into the existing method:
 - a. Burros will be stuck in a row, and confined to a pick/pack team, reducing their impact
 - b. Expect a 20-30% gain in output per day, across as many people as you have in the row
 - c. Possible to pick out full rows, enabling half the number of pack table moves

Scenario 1



Here is an operating Model (shown also in the tables above) where you can make different assumptions about Burro, Burro speeds, and field layouts:

https://burro.ai/wp-content/uploads/2020/03/Burro-table-grapes-op-model_protected.xlsx