Mechanical Harvesting – Tools of the trade

S. Kaan Kurtural
Department of Viticulture and Enology

Why Mechanical Harvesting?

Harvest is labor intensive.

- 6 people to harvest 1 ton in 1 hour.
- *(pc-rate pay = faster work)*

Labor is expensive.

- @ $9.00/hr x 1.38 x 6= $124/ton
- (*pc-rate pay = $240+/ton*)

Labor may be hard to find.

You need to harvest NOW!

You are a warm climate grower – night harvest = cooler fruit delivered

Economics

Hand Harvesting

- Going piece rate is $80-120+ per ton
- 5-6 people (on avg) to pick a ton of grapes in one hour
- @ 7 ton/acre = 35 man-hours per acre = $560-$700/ac
- You need 4 truckloads in 8 hrs? You'll need 60 people!

Machine Harvesting

- Costs range from $275-325 per acre
- 3 people can harvest 2.5 to 3 acres per hour (*10' rows, 2+mph*)
- = 17.5 – 21 tons per machine hour (@ 7 ton/acre)
- = 1.0 – 1.2 man-hours per acre (= 97% savings)
- Cost / ton = $40-50 per ton (= 50% savings)
- Harvest 4 truckloads in 4.5 hours

Annual savings on 300 acres = $28,000 to $35,000

Mechanical Harvest

- Generally will pick 5 tons/H
- Equates the work of 100 workers
- If time is of essence this is the best option
- Harvest can be done at night when temperatures are low
- This ensures high fruit quality fruit
  - On-board sorting
- Avoids premeature fermantation

Modern Grape Harvester Brands

- American Grape Harvester (USA)
- AIM (USA)
- URM (Australia)
- Nairn (New Zealand)
- Oxbo-Korvan™ (USA)
- Gregoire (France)
- Pellenc (France)
- Braud/New Holland (Europe)

Two Main Types of Modern Grape Harvesters

Self-Propelled

- Engine driven
- Hydrostatic drive system

Tow-Behind

- Requires a tractor to pull and supply power via PTO
- Some have hydrostatic drive “assist” for hill climbing

Self Propelled –

SP – 3216 Wide Trellis Machine – up to 48” cross arms

Tow-behind

- Cheapest alternative
- A larger tractor is needed (>80 hp)
- Addition of one more laborer to drive the harvester

Major Components of a Grape Harvester

- Chassis / Power Unit
- Picking System
- Catching System
- Conveying System
- Cleaning System

Chassis / Power Unit Comparison

Self-Propelled

- Advantages:
  - Maneuverability
  - Stability (in most situations)
  - Ease of Operation
  - Less vine damage
  - Less trellis damage
- Disadvantages:
  - Higher initial cost
  - Fixed hp
  - Power unit not easily substituted

Tow Behind

- Advantages:
  - Select power unit hp based on situation
  - Safer to use on extreme slopes and side-hills
  - Lower initial cost
  - Power unit easily substituted
- Disadvantages:
  - Tend to “duck-walk”
  - Tend to cause more vine and trellis damage
  - More difficult to operate

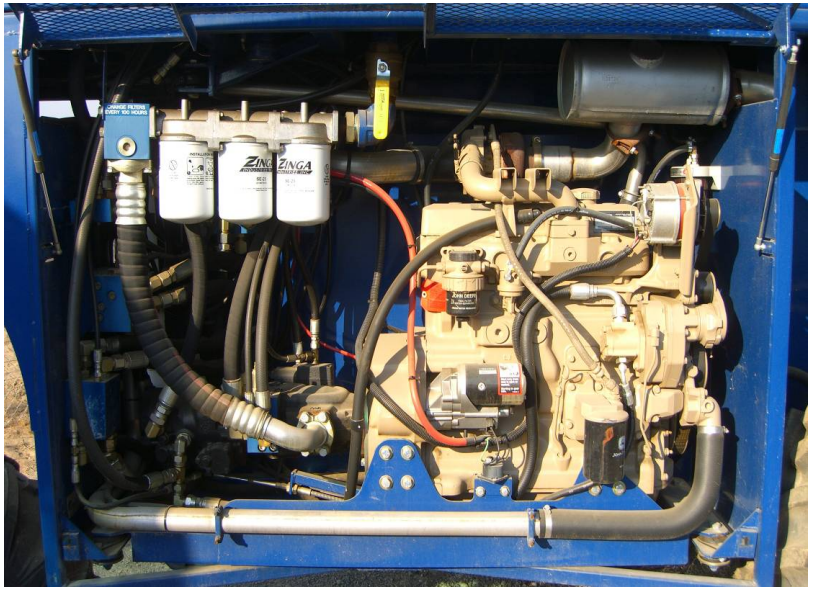
Chassis: Engine Compartment

Mounted low

- Low CoG
- Ease of Maintenance
- Better visibility
- Less noise for operator

In this general area:

- Engine
- Hydraulic Pumps
- Filters



Chassis: Side Leveling

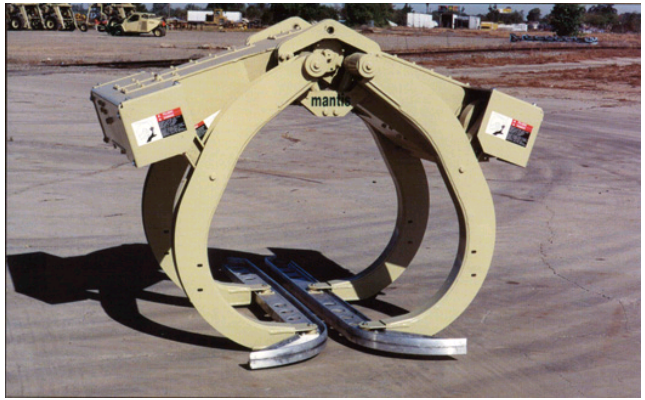
Many harvesters have:

- 24” of total lift
- 18” leveling capacity
- = 15% slopes
- = 8.5°
- = 18” in 10’

Newer models have:

- 30” of total lift
- 24” of leveling capacity
- = 20% slopes
- = 11°
- = 24” in 10’

Review of Picking Heads



Trunk Shaker

For ‘tight’ cluster cultivars

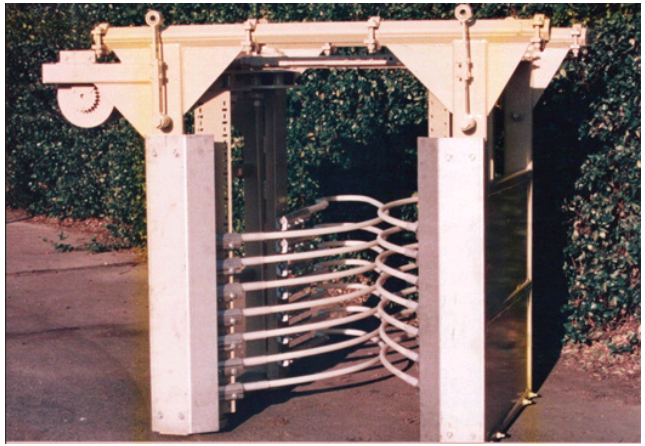
Some wide trellises

Raisin types

Table grape tailings

Trunk Shaker System

Review of Picking Heads



Flexible bow-rods

- Most common
- Cheaper to operate

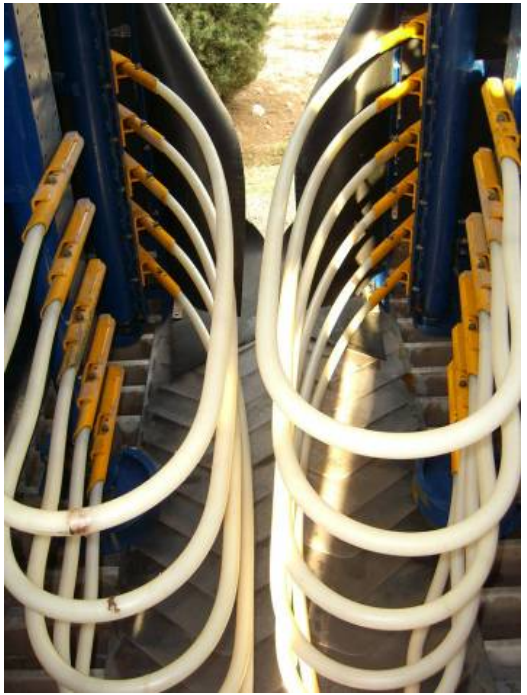
Picking System: Bow Rod Head

Extruded and formed
1.0” dia. nylon rods

Steel, aluminum, or UHMW rod holders

Adjustments:

- Stroke (4-8”)
- Rod spacing (2.5-8”)
- Rod tension (firm)
- Throat width (best fit)
- RPM (300-450)
- Forward speed (1.0-3mph)



Bow Rod Picking Head

Wide Trellis Head / Indexing Bow Rod Head up to 48” cross-arms

Catching System

- Lexan or Nylon catcher plates
- Designed like flower petals or overlapping leaves
- Continuous overlap from front to rear and side to side
- Plates open and close only as needed to work around vine trunks and trellis posts
- Uni-directional – YOU CANNOT BACK UP!!!

Bucket Conveying System

High impact plastic buckets

Attached to roller chains and hydraulically driven

Fruit is carried in an almost static state

- No dragging
- No rolling
- No unnecessary dumping

Probably half of all harvesters have bucket lines, other half have flat or cleated belting

MOG

Material Other than Grapes

- Canes
- Leaves & Petioles
- Other Debris

Allowable Levels are quite low

- 2-5% by weight

How to Avoid

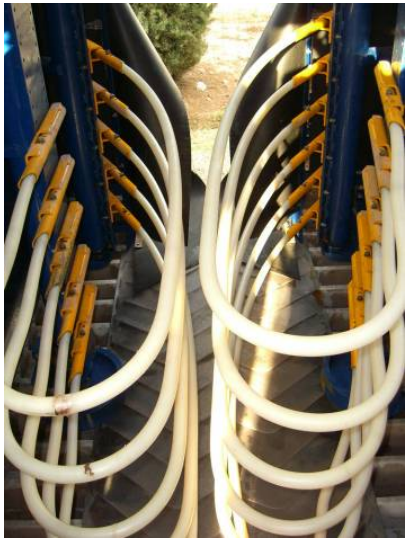
- Proper Harvester Settings - Don’t Pick It!
- Remove It…

Proper Harvester Settings

Bow Rod Machine

Rod tension
Pinch gap / rod overlap
# of rods
Spacing between rods (vertically)
Placement of rods (height)
Head speed (RPM)
Travel speed (MPH)

Driver must stay centered!



Proper Harvester Settings

Trunk Shake Machine

Head tuning – weights must be in time

Pinch pressure/Pinch Spacing

Placement of rails (height)

Head speed (RPM)

Travel speed (MPH)

Driver must stay centered!

MOG Pre-Cleaning Systems

Rotary MOG Deflector

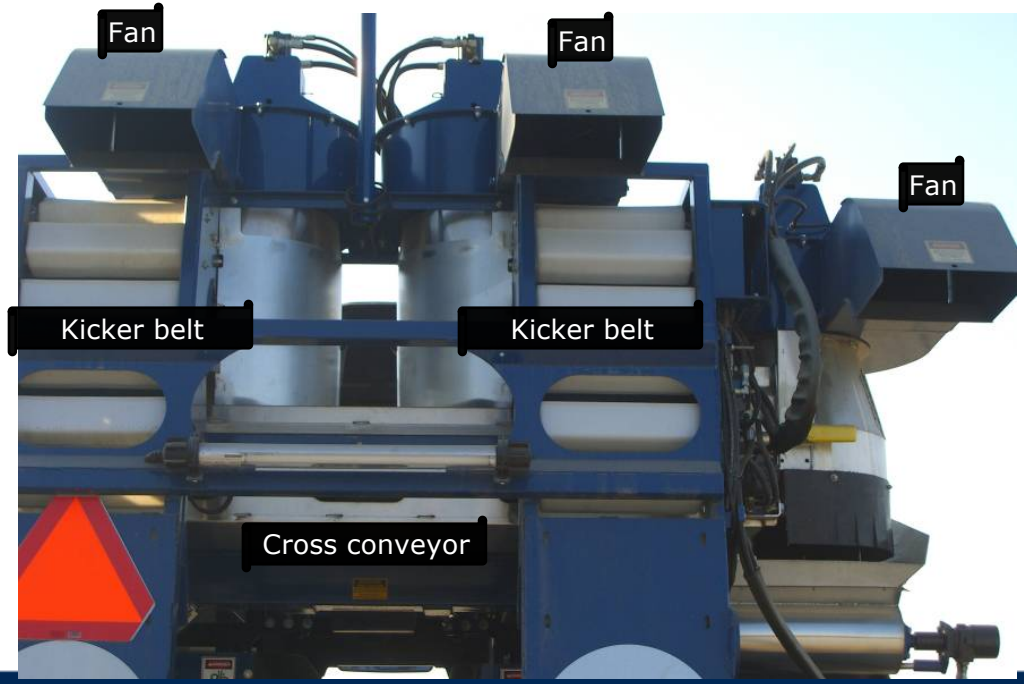
- RPM, Direction, and Position is Adjustable
- Removes loose debris
  - Leaves
  - Canes
  - Green shoots
- Prevents Balling-Up in lower corner of bucket line
- Eliminates Need for “Walkers”

MOG Pre-Cleaning Systems

MOG slider tubes

- More of a Passive device
- Stationary mounted at rear of harvester
- Guide large canes and sticks off to the side and out of the buckets

Upper Belts and Fans



Main Conveyor System

Upper “kicker” belts

- catch fruit from the bucket lines
- Direct fruit inward and under the primary cleaning fans

Lower “cross conveyor”

- collects fruit from kicker belts and directs fruit toward OTR conveyor

Cleaning Fan System

Three cleaning fans pull large amounts of air through the fruit at “air drops”

- Two primary fans
- One secondary fan

Leaves are the primary goal

Smaller canes and green shoots too

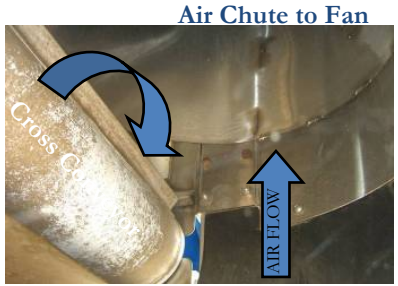
Final/Secondary Cleaning Fan

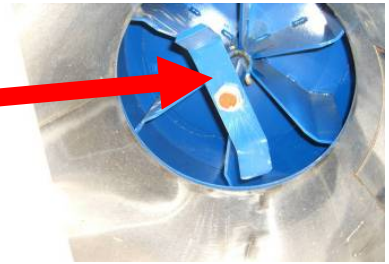
Mounted at the outer end of the Cross Conveyor

- Fruit falls through air drop and lands onto the OTR conveyor
- Speed is adjustable - independent of other fans

Stick breaker

- Grabs canes
- Reduces clogging





OTR Conveyor System

OTR = Over The Row

Conveys fruit from final air drop area, over the adjacent row, and into a companion gondola or bin trailer

Swing and Height are hydraulically adjustable by operator

- **Use 2 gondolas in heavy yields or long rows!**

Magnet on OTR Conveyor

Optional high power magnet removes ferrous materials, like:

- pieces of wire
- staples
- VSP clips
- Wrenches
- Screwdrivers
- ***Things that might demolish an expensive pump at the winery!***

Quality Control Issues

% of Fruit Remaining
- 1-2%, up to 5% is OK, really!
- Don't "over-pick"
- Leave Rot and Raisins on the vine

% Leaf Area Remaining
- 50% is supposed to be enough for vine recovery
- 70-80% is much better

Damage to trunks, cordons, arms, spurs, etc.
Trellis Damage
Fruit Damage / Juicing
M.O.G. level

Quality Controls – cont'd

Fruit Temperature

- During harvest primarily
- Loads temps do not change rapidly

Oxidation Issues

- Time in Transit
- Wait Time at Winery
- Crush pad wait times

Cultivar Differences

The same harvester settings will not work in every vineyard

Adjustments must be made to optimize the harvest

Certain cultivars are quite easy to harvest by machine

Other cultivars are challenging

Trellis and Training

Vineyard design and maintenance plays a big role in mechanical harvesting success

- Good stakes and cross-arms
- Short cordons (<4 ft for trunk shakers)
- Tight cordon and foliage support wires
- Trunks, heads, and cordons are well supported, tied and kept inline with the row

It's all about energy transfer and rapid reversals from the harvester, through the trellis/vine combo, to the grapes.

When things are sloppy in the vineyard, you're going to get a sloppy harvesting job.

- *You can't push a rope!*

THANK YOU FOR LISTENING!