Forward step to continuous mechanical harvesting of olive orchards with lateral canopy shakers

AGR126. MECANIZACIÓN Y TECNOLOGÍA RURAL

UNIVERSIDAD DE CÓRDOBA

INTRODUCTION

There is a problem with traditional olive orchards

What we can do?
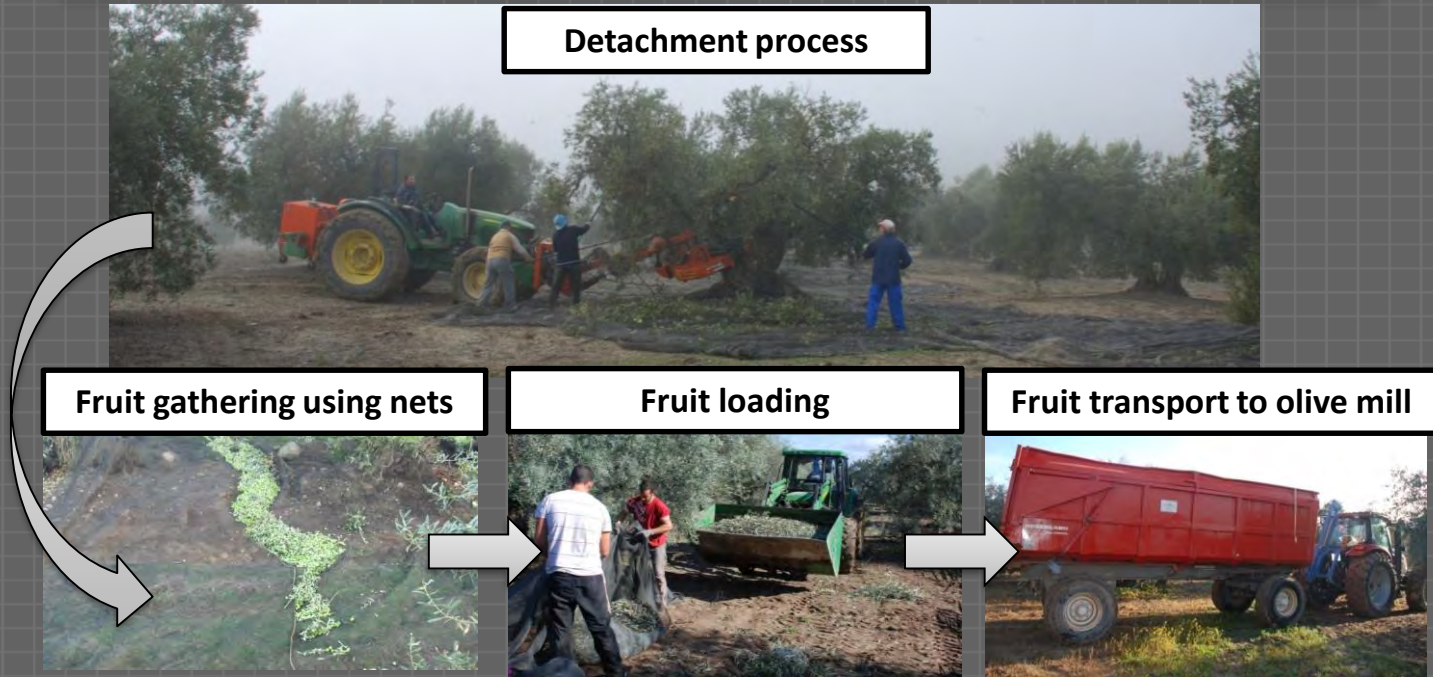
To introduce improvements by mechanization

¿Harvester?

How is the situation of the olive sector?

O L I V E   S E C T O R

Pie chart legend:
- España
- Italia
- Grecia
- Tunez
- Siria
- Turquia

Pie chart values: 38%, 23%, 14%, 6%, 5%, 4%, 3%, 1%, 2%, 1%, 4%

Mechanized 25%

TM

Mechanized 75%

Mechanized 0%

TNM

Mechanized 100%

I

S

S
I
TNM
TM

OLIVE SECTOR
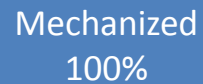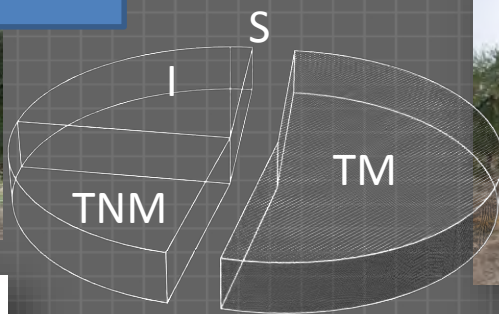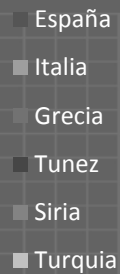
Harvesting in traditional orchards

Detachment process

Fruit gathering using nets

Fruit loading

Fruit transport to olive mill

4

P r o f i t a b i l i t y

Olive growing cost by orchard (without subsidies) 2012

EVOO
OO
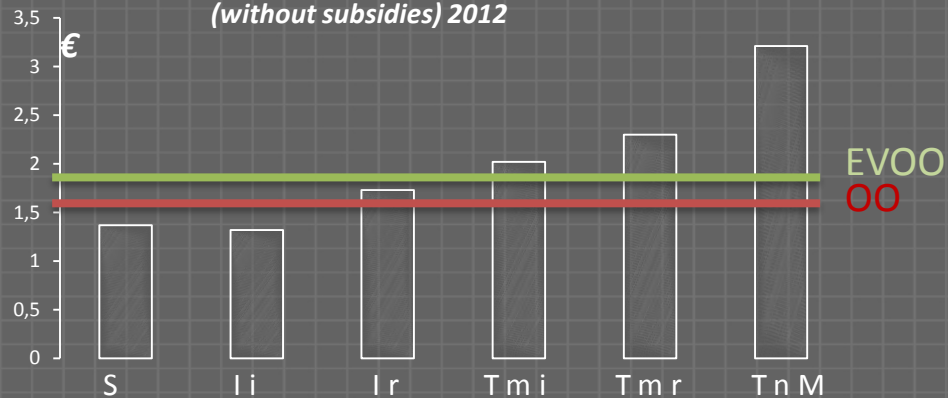
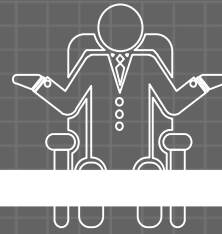|	Cost percentage (%)	
	TM rainfed	TM irrigated
Pest	11,9	7,9
Pruning	17,0	11,4
Fertilization	5,1	3,4
Soil	26,7	17,8
Irrigation	0,0	19,2
Harvesting	39,3	40,2
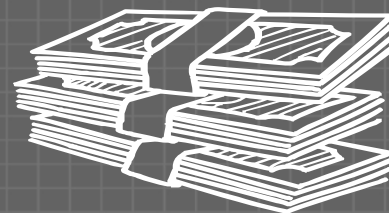
Harvesting history

VI aC

. . .

XX-XXI dC

✓ *Vibration on bearing branches*
✓ *Continuos harvesting*
✓ *Detach and catch fruit*
.

Tree training
Large spacing between trees
▪ *Canopy contact*

INTEGRAL HARVESTING:
THE KEY

DETACHING

CATCHING AND NETS MOVING

LOADING FRUIT
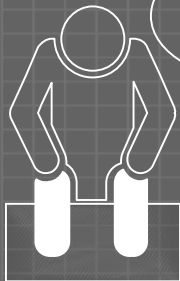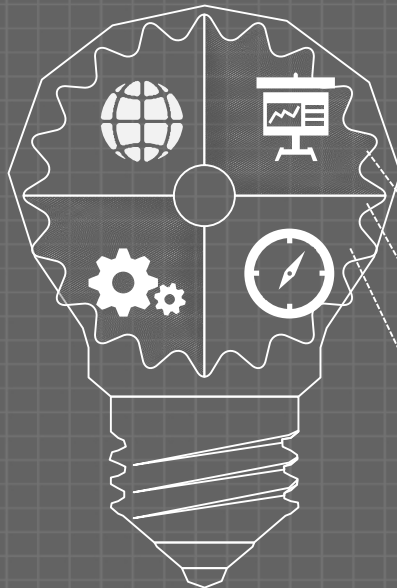
LOADING FRUIT

MILL

OBJETIVES

IS IT POSSIBLE THE INTEGRAL HARVESTING OF TRADITIONAL OLIVE ORCHARDS

Develop a continuous harvester for traditional olive orchard based on canopy shaking

MAXIMiZE
- Kg per time

MINIMIZE
- Costs

ENHANCE
- Oil quality

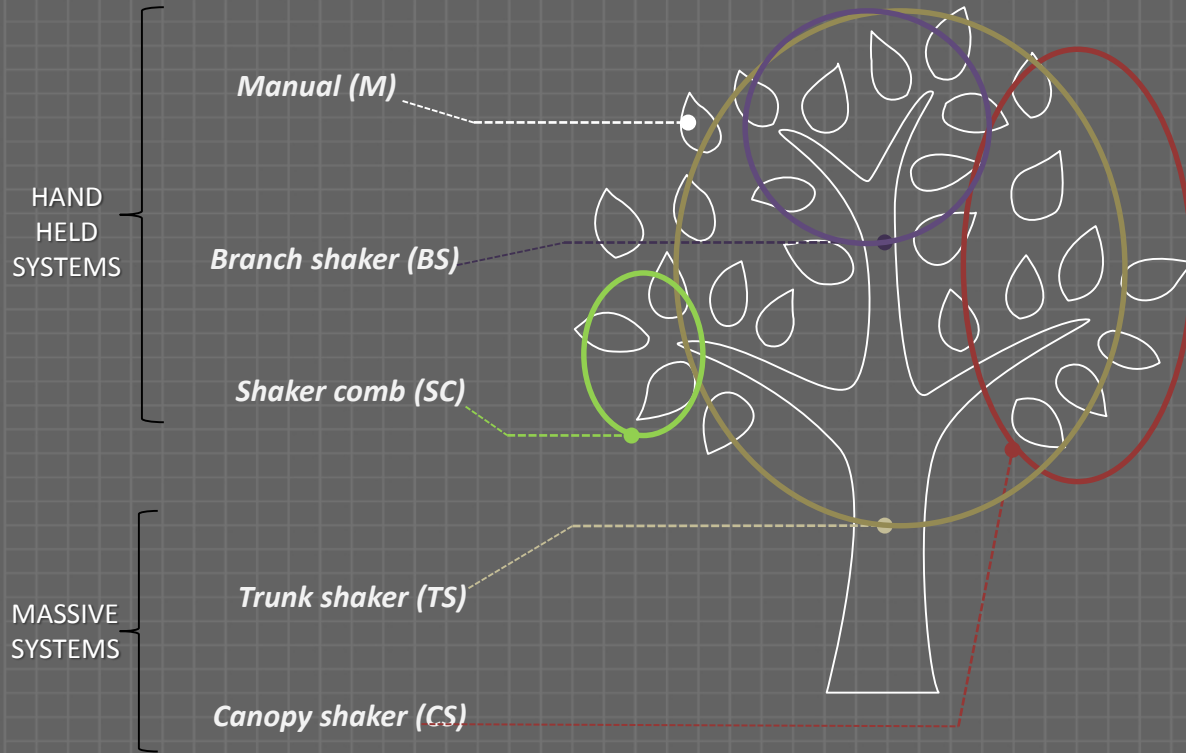1. Available methods for harvesting

2. Canopy shaker background

3. Harvester design
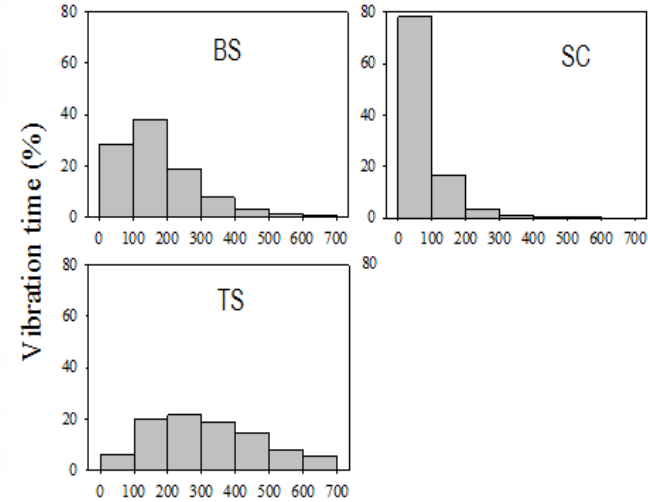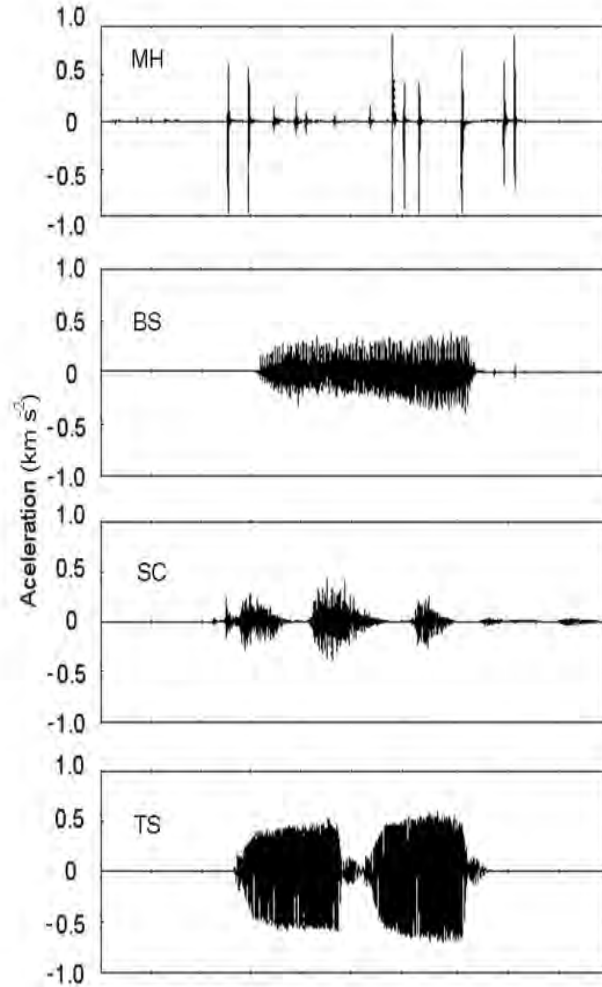
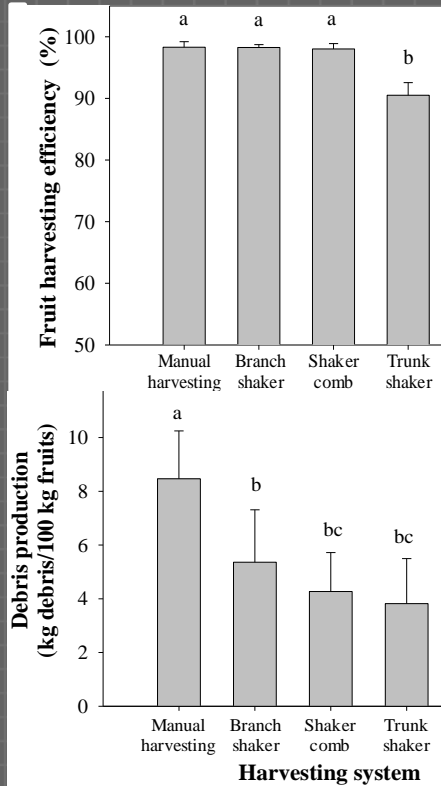Orchard and trees characterization

Shaker head

Harvester

1. AVAILABLE HARVESTING METHODS

Manual (M)

Branch shaker (BS)

Shaker comb (SC)

Trunk shaker (TS)

Canopy shaker (CS)

HAND HELD SYSTEMS

MASSIVE SYSTEMS

1. AVAILABLE HARVESTING METHODS

	Frequency (Hz)	Mean resultant acceleration (m s^{-2})
M	n.a.	676 ± 449*
BS	16.6 ± 1.3 c	193.2 ± 53.9 b
SC	13.5 ± 0.3 b	71.3 ± 35.1 d
TS	24.2 ± 1.0 a	343.1 ± 138.0 a

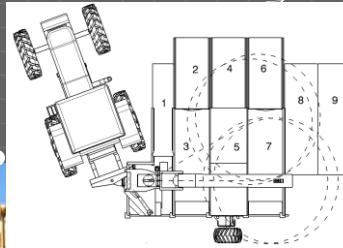# 2. CANOPY SHAKING BACKGROUND
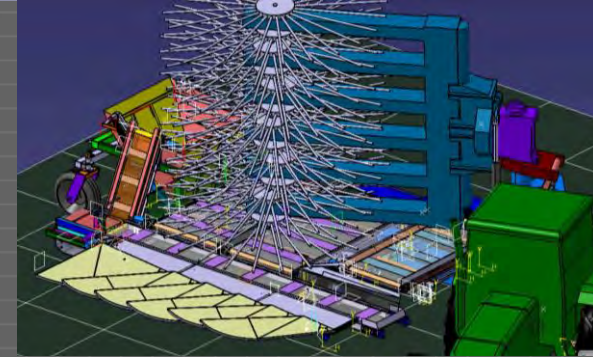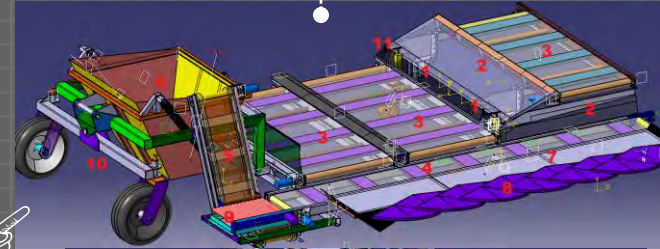
CS in other crops

CS in olive trees?

Harvest efficiency?

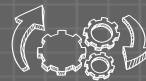**Harvester?**

2. CANOPY SHAKING BACKGROUND

CS in other crops

CS in olive trees?

Harvest efficiency?

Harvester?

DRUM

APPROACH SYSTEM

AMPLITUDE AND FREQUENCY

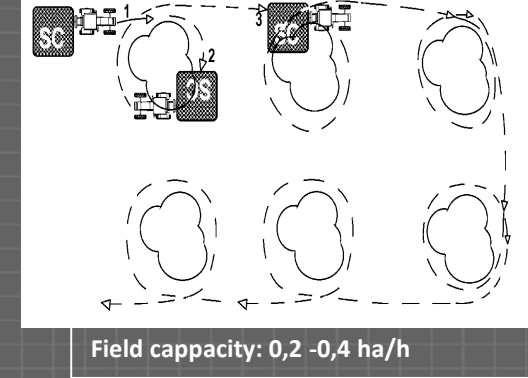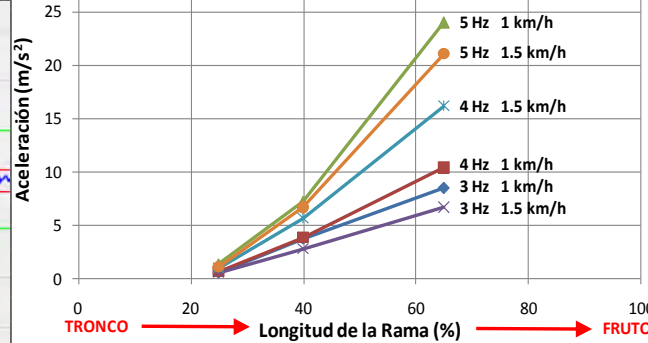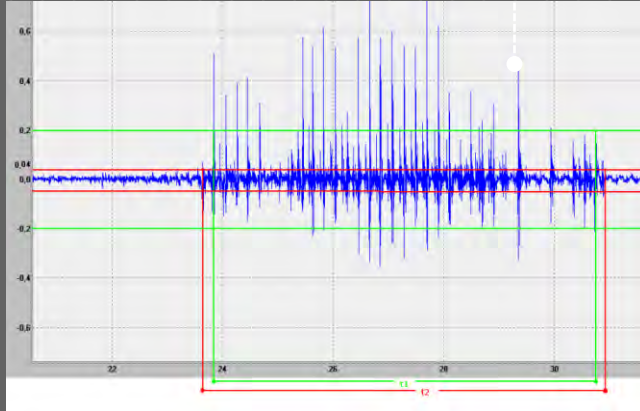SHAKER HEAD

2. CANOPY SHAKING BACKGROUND

CS in other crops

CS in olive trees?

Harvest efficiency?

Harvester?

Chart axes: Aceleración (m/s²) vs Longitud de la Rama (%), TRONCO → FRUTO

- 5 Hz 1 km/h
- 5 Hz 1.5 km/h
- 4 Hz 1.5 km/h
- 4 Hz 1 km/h
- 3 Hz 1 km/h
- 3 Hz 1.5 km/h

Field cappacity: 0,2 -0,4 ha/h

✓ *Vibration pattern with shots of high amplitude and short duration*

✓ *Frequency (4-5 Hz) and ground speed (1 km/h)*

✓ *Low vibration transmission*

✓ *It is possible harvest around trees*

✓ *Tree training for irregular canopies*
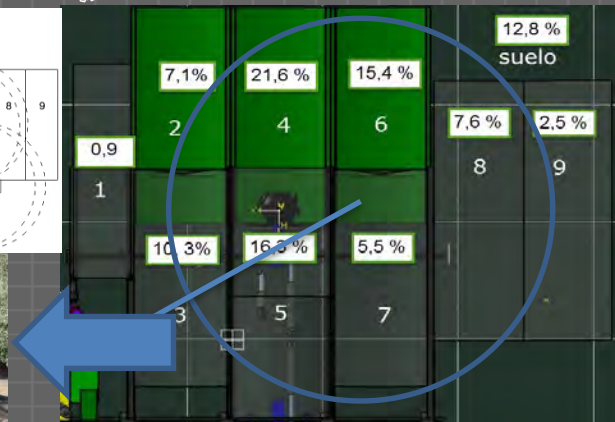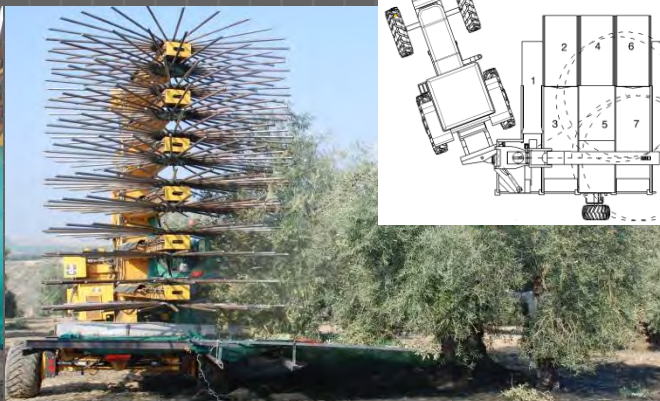
2. CANOPY SHAKING BACKGROUND

CS in other crops

CS in olive trees?

Harvest efficiency?

Harvester?

- ✓ *Catch frame according to rod area*
- ✓ *Removal and catch efficiency acceptable*
- ✓ *Learning of the driver*
- ✓ *It is necessary a CATCH FRAME PROTOTYPE ADAPTED WITH PLATES*

TEST	Edo (%)	Ec (%)	Eh (%)
1	66,9	84,8	56,7
2	62,0	90,0	55,8

11	81,0	90,0	72,8
12	81,7	90,6	74,0
Mean+SD	**75,9±6,5**	**87,6±2,2**	**66,5±6,2**

CS in other crops

CS in olive trees?

Harvest efficiency?

Harvester?

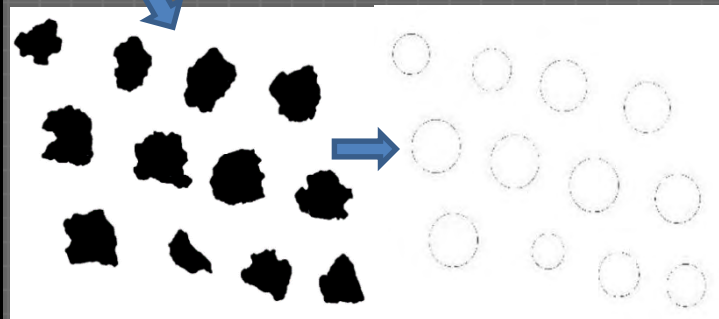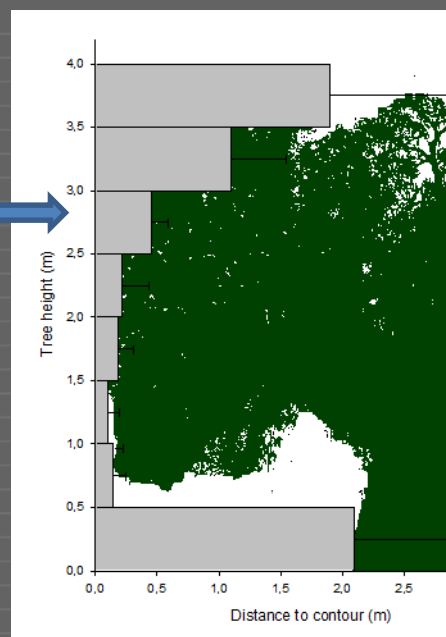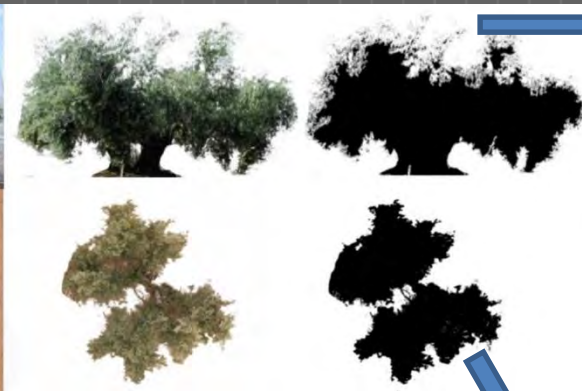| PARAMETERS	
E removal (%)	92,4±3,9
E. catcj (%)	92,2±3,5
E harvest (%)	85,3±4,6
Debris (kg /kg fruit)	5,6±2,4
t (s/tree)	110
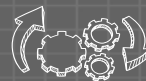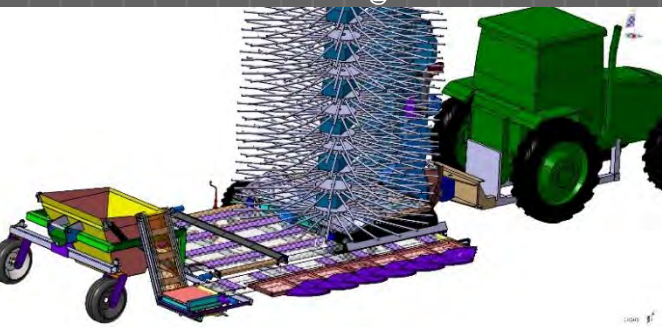
- ✓ *IT IS POSSIBLE THE INTEGRAL HARVESTING*
- ✓ *There is necessary a new harvester softer and adapted to orchard conditions*
- ✓ *There is necessary a tree training for the harvesting method*
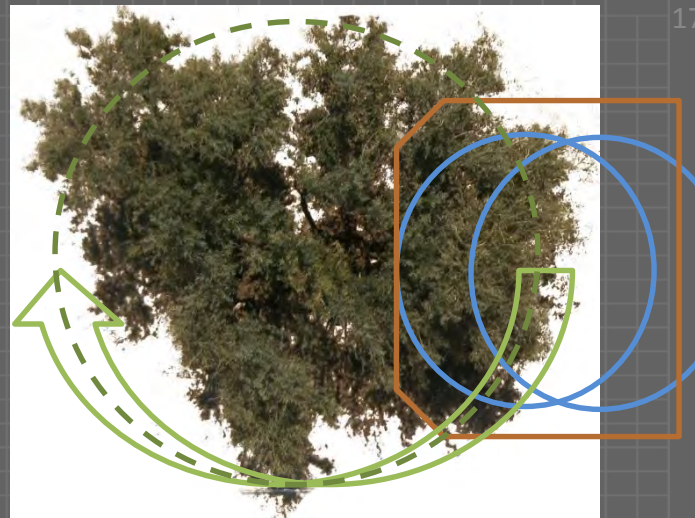
3. HARVESTER DESIGN

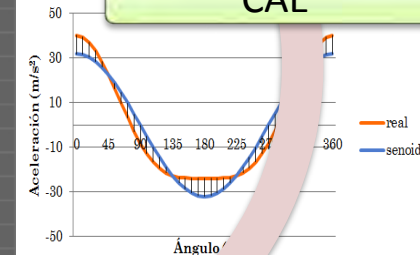## TREES FEATURES

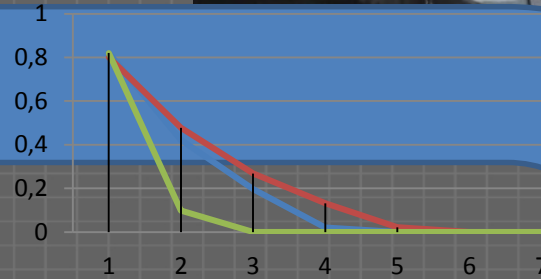# 3. HARVESTER DESIGN

TREES FEATURES

3. HARVESTER DESIGN

SHAKER HEAD

CAD

CAE

RESULTS

TESTS

CAM

SHAKER HEAD

SHAKER MODULES OLIVE

SHAMOLIV
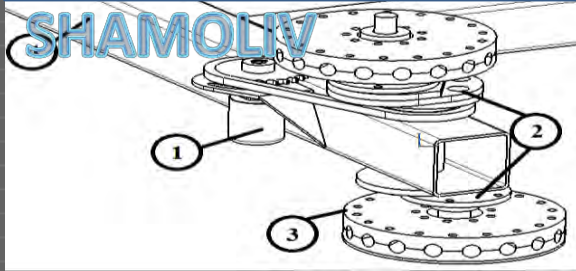
ACERO RECUBIERTO DE MATERIAL PLÁSTICO

FIBRA DE VIDRIO

FIBRA DE CARBONO

HARVESTER

HARVESTER.
arrangement

Neutral position

80cm

Approach min.

Approach max.
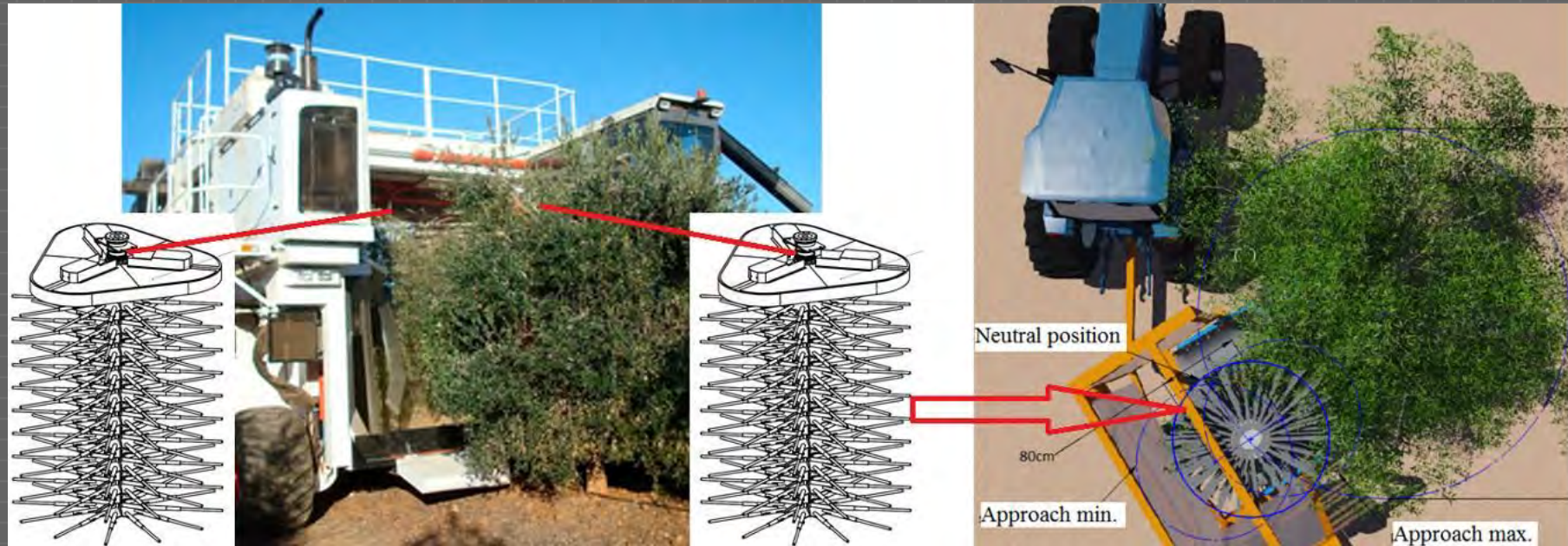
HARVESTER.
arrangement

CONCLUSIONS

First precomercial harvesters have been developed introducing the integral mechanization in traditional orchards to maintain the profitability thresholds .

The modernization process in this traditional sector of agriculture will require a great effort taken into account that traditional olive growing is one of the world's oldest tree crops and is immersed in a culture that is resistant to change

The ongoing on a commercial harvester require a longer-term for tree training, machine improvements and cost optimization with a close collaboration between researchers, farmers and manufacturers.
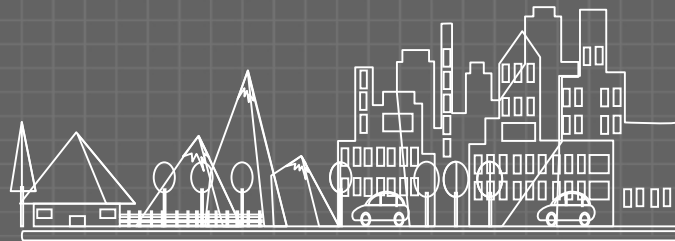
Line 1

Canopy shaker harvesters

Line 2

Trunk shaker harvesters

Line 3

Automatization and pad system for trunk shakers

Line 4

Airblast sprayer
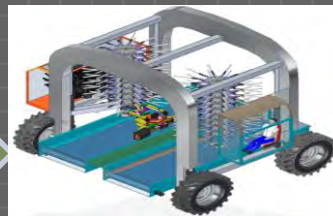
Line 5

Tractor mower and automated sprayer

MECHANIZATION

LINE 1 — Straddle harvester based on trunk and canopy shakers for intensive orchard
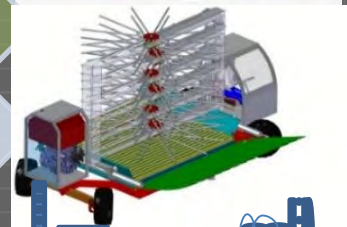
LINE 2 — Multipurpose vehicle for high gradient slope

LINE 11 — Lateral canopy shaker for table olives orchards

LINE 12 — Real-time and traceability systems for mechanical harvesting of table olive

ENVIROMENT

LINE 3 — Air blaster with real time dosage, variable rate application and zero spare material for traditional and intensive orchards
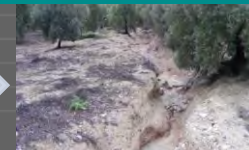
LINE 4 — Integral equipment for grouping, chopping and managing the pruning remains

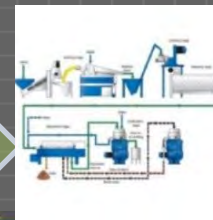**LINE 5** — Prevention and control of soil erosion and gully correction
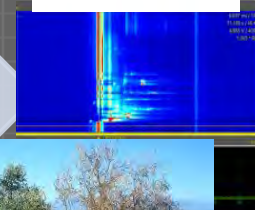
INDUSTRY

LINE 6 — New systems and technologies to improve the virgin olive oil processing

LINE 7 — Analytical instrumentation for extra virgin olive oil classification.

BIO-TECHNOLGOY

LINE 8 — Pre-commercial formulation of antagonist fungi for olive verticillium control

LINE 9 — Pre-commercial formulation of entomopathogenic fungi for olive fly Bactrocera oleae (Gmelin) control
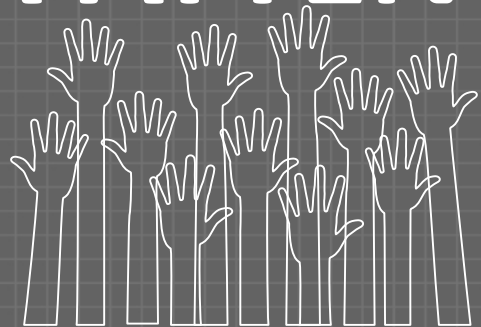

LINE 10 — New olive varieties adapted to high density orchards

Thanks to:

THANK YOU FOR YOUR ATTENTION

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