

# Mechanical Harvesting and Pruning of Tea

Sampath Pathiranage  
Senior Research Officer  
Agronomy Division

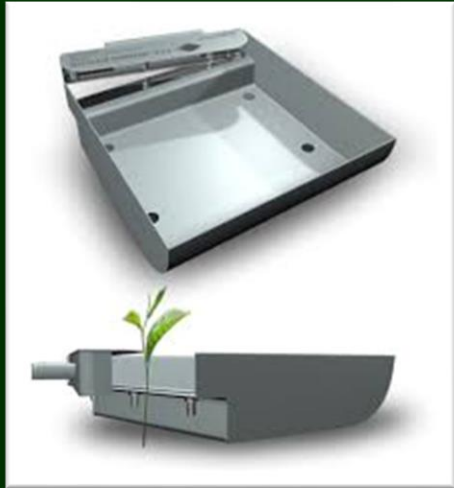


# Introduction

- Tea is a highly labour intensive crop
  - 70% field labour for manual harvesting
  - It contributes about 40% in COP of made tea
- Severe worker shortage in tea sector.
- Mechanization is the only apparent alternative
- **Benefits of mechanization**
  - Increase the labour productivity
  - Decrease COP
  - Increase the quality of the product
  - Ease of operation
  - Complete cultural practices in time
  - Change in worker attitudes



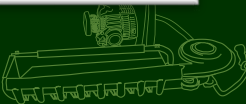
# Mechanical harvesting of tea





Use of shears



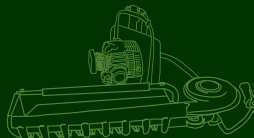
Motorized harvesters



# Use of shears for tea harvesting

	TRI selective harvesting shear (TSHS)	Other shears with long handles
Output (kg/day)	30-50	25-40
Over-mature parts	Negligible	10-15%
LPH*	6-7	10
		

*\*12 LPH for manual harvesting*



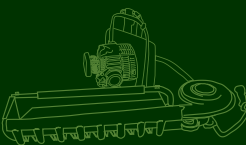




Time - 33 secs.  
Number of cuts 60

If only one shoot is  
picked per cut...

42 kg/day  
(day = 6.5 working  
hours)





# Use of Selective Harvester

## Shear are more suitable...

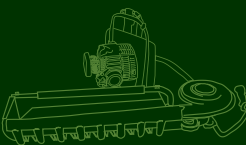
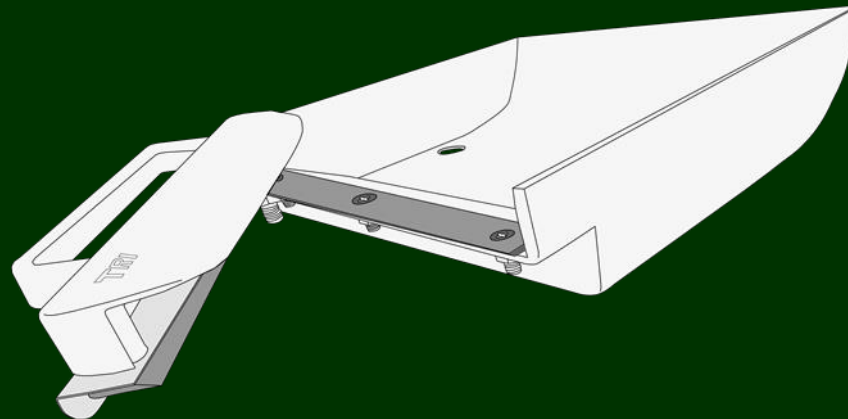
- High yielding lands
- Cropping season
- Flat or undulating lands
- Higher productivity when using plucking baskets
- More suitable for young workers

## Avoid shearing ....

- Lean months
- First 6-12 months after bringing into bearing
- First 6 months - tipping after pruning.

## Advantages of SH

- Higher labour productivity
- Needs less labour
- Better plucking standard
- Selective harvesting
- Preserves bush health
- Minimum maintenance



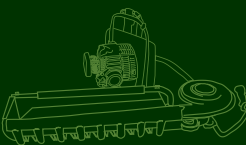
# Tea harvesting machines



In Sri Lanka



Other tea growing countries







Fresh flush (kg/day)

60-250

(Manual - 20)

Over-mature (maintenance foliage)

5-10%

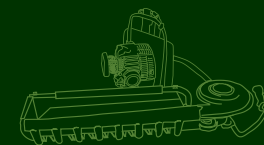
Ha/day

0.3-0.8

(Manual 0.10: 10 LPH)

Fuel (Litres/day)

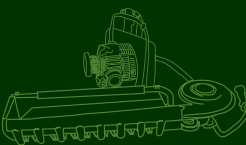
5-6





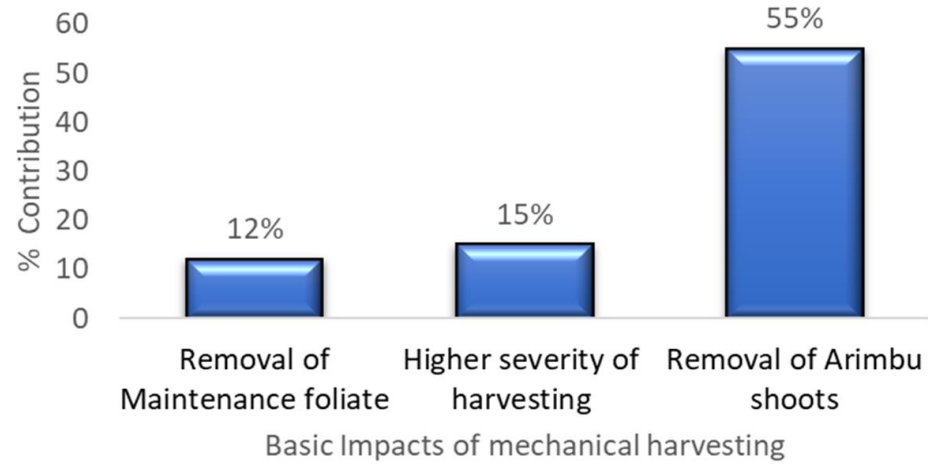
# Problems with plucking machines

- Crop loss in continuous usage (Quantitative losses compared to manual selective 7-day rounds)
- Weakening of bush health in continuous use
- Over-mature parts in harvested crop (qualitative losses)
- Difficulty to use on slopes
- Obstacles in field (drains, shade trees, etc.)
- Need of trained labour
- Capital and maintenance costs
- Price of fuel

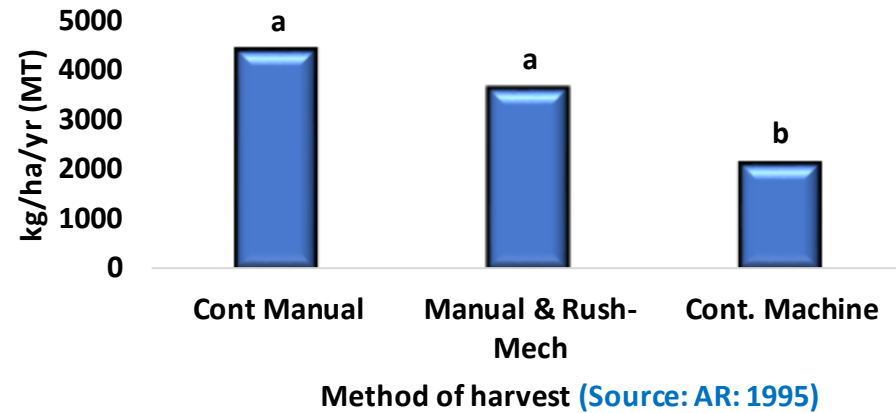


# Minimizing practical problems – Experimental facts

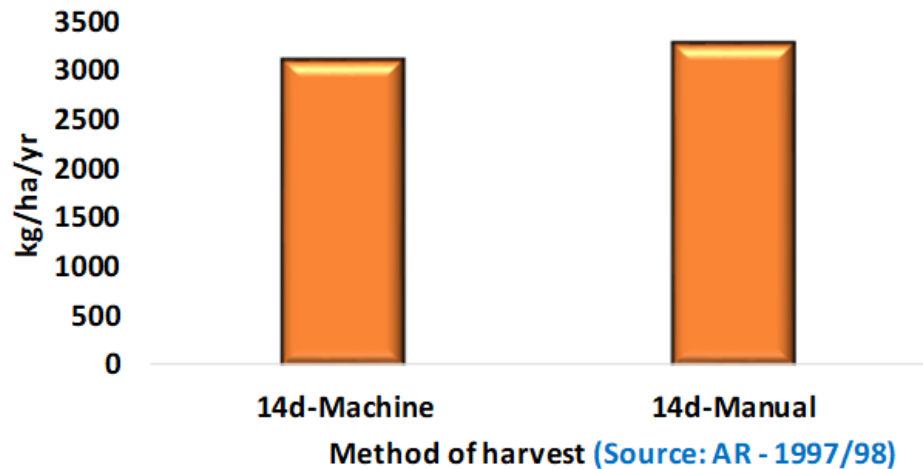
1 Contribution in the yield reduction



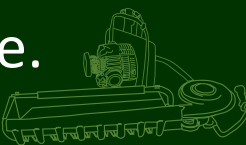
2 Machines during rush crop and manual during lean months



3 Machines Vs. Manual Extended rounds



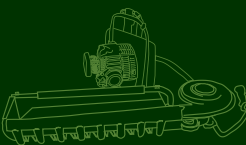
1. The main cause of yield reduction is removing Arimbu shoots. Therefore, DO NOT cut deep into the table.
2. Using machine only during rush crop doesn't drop the yield
3. Tea yield in manual delayed rounds and mechanical harvesting showed no considerable difference.



# Practical approaches to minimize problems

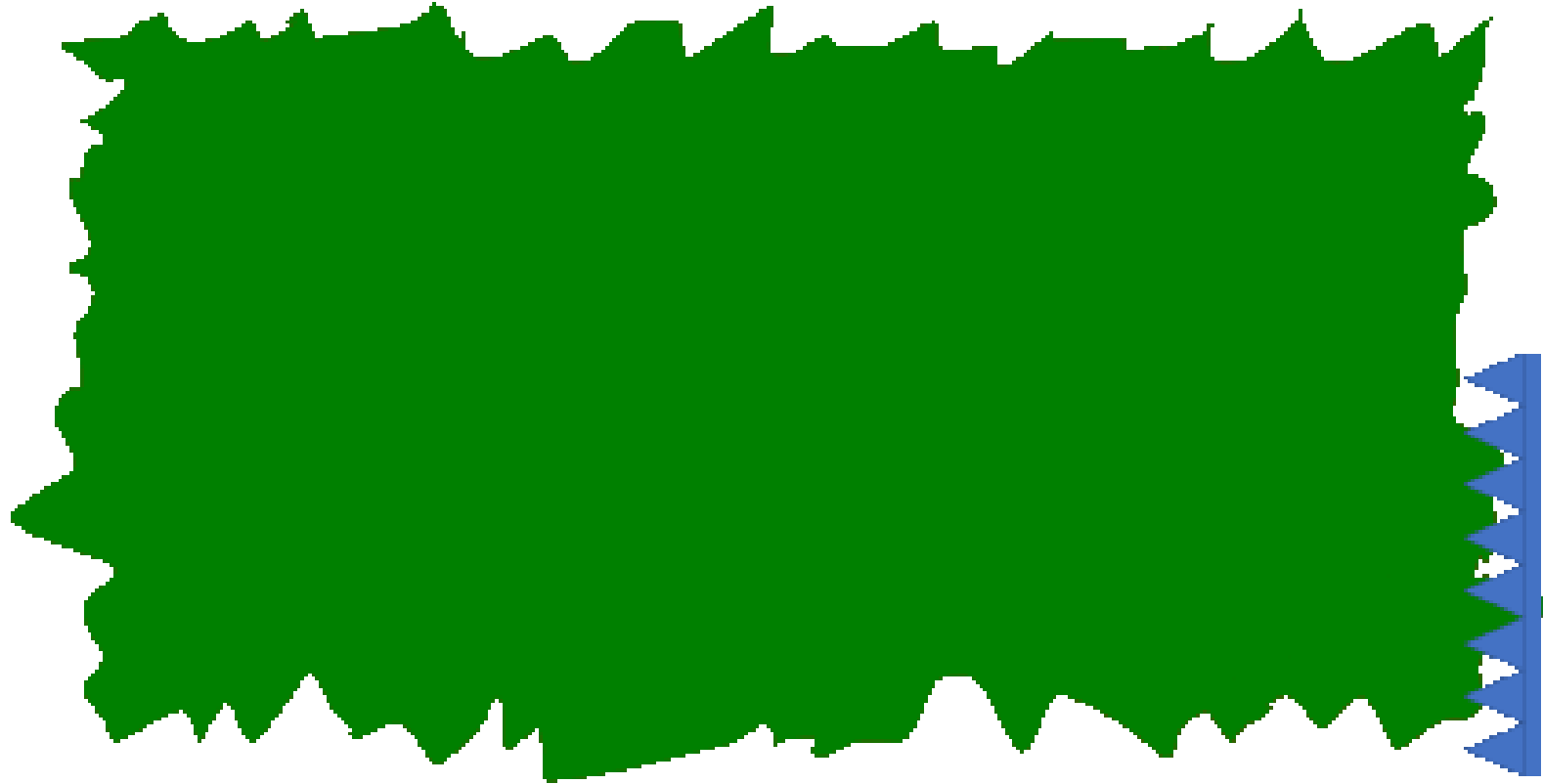


Avoid cutting the same point more than once

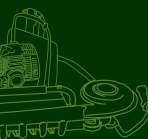


# How to operate the machine on the table

## Straight run



- High speed of operation
- More suitable for flat tea lands



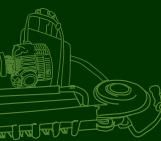


# How to operate the machine on the table

## Scrape back



- Scraping action towards the operator
- Suitable for tea lands with a slope



# How to operate the machine on the table

## S-shape Cut



- Continues to the next tea bush
- Speed operation is moderate



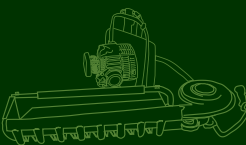
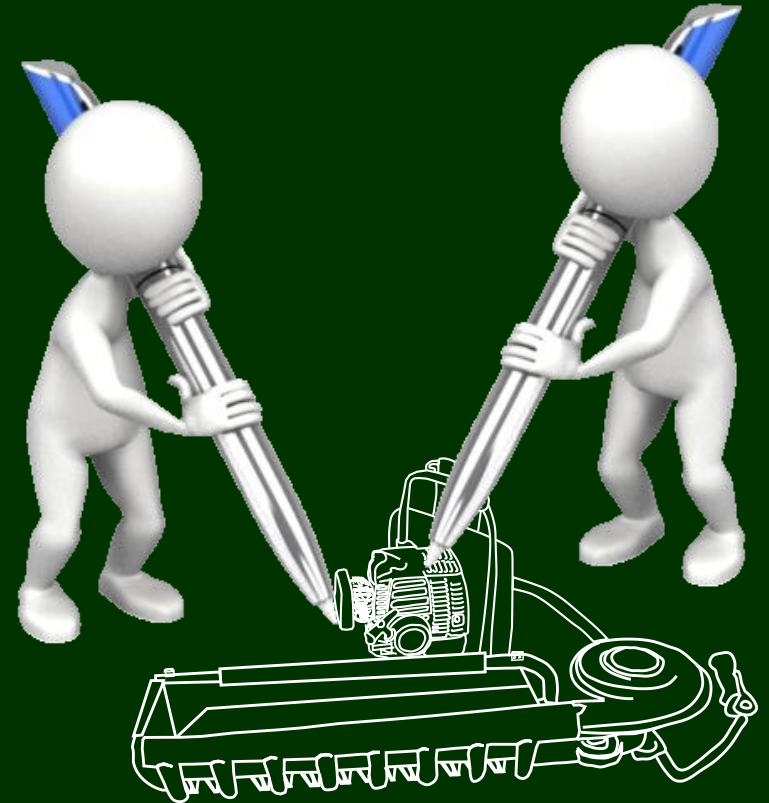
# Summary – minimizing problems

- Use machines only if the plucking rounds are continuously delayed.
- Use of machines only during the rush crop
- Do not cut deep into the plucking table
- Never cut the same point more than once
- Remove over-grown parts, if any
- Manage other environmental stresses
  - Shade management
  - Fertilizer management
  - Zn/Urea
  - Irrigation
  - GAP
- Rest before pruning
- No machines in young fields
- Select machines
- Training and supervision



# Development of motorized selective tea harvesters

- Funded by Ministry of Plantations
- TRISL special projects
- 2 external engineering firms
- Prototypes testing on going
- Intend to introduce them shortly



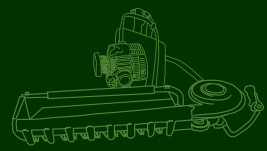


# Planting tea to facilitate the use of machines

- Conventional tea planting – 0.6x1.2 m (2x4 feet) has limited space between tea rows.
- Difficult to use machines / decrease productivity of machines
- Double hedge-row planting facilitates the use of machines and improves labour productivity



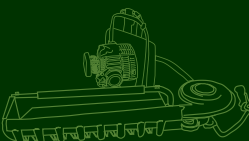


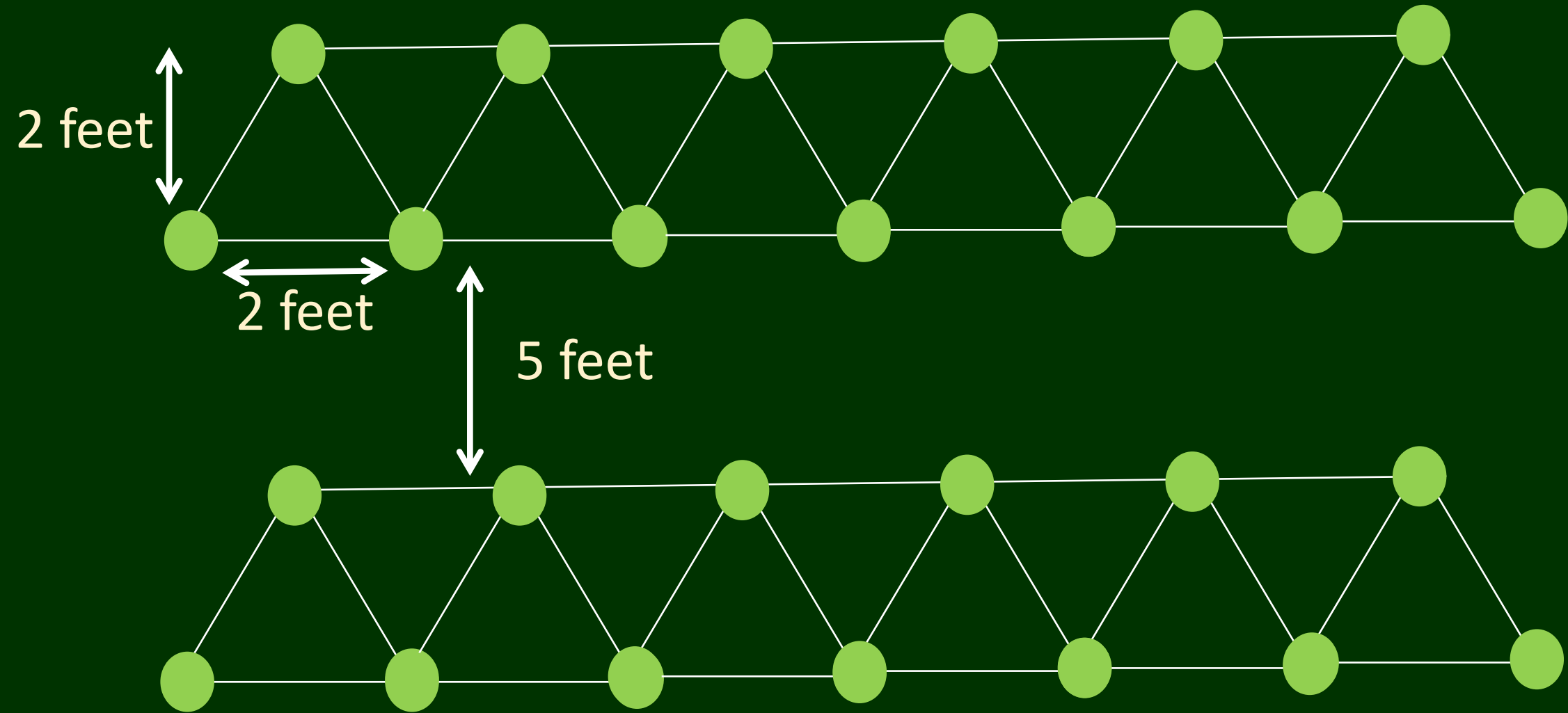




# Double hedge-row planting system

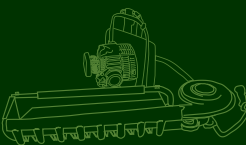
- Planting spaces 0.6x0.6x1.5 m (2x2x5 feet)
- This provides adequate space for the machine and operator
- Used in countries like Japan/China
- About 14% more bushes
  - Conventional method → about 12500 bushes/ha
  - Double hedge-rows → about 14000 bushes/ha

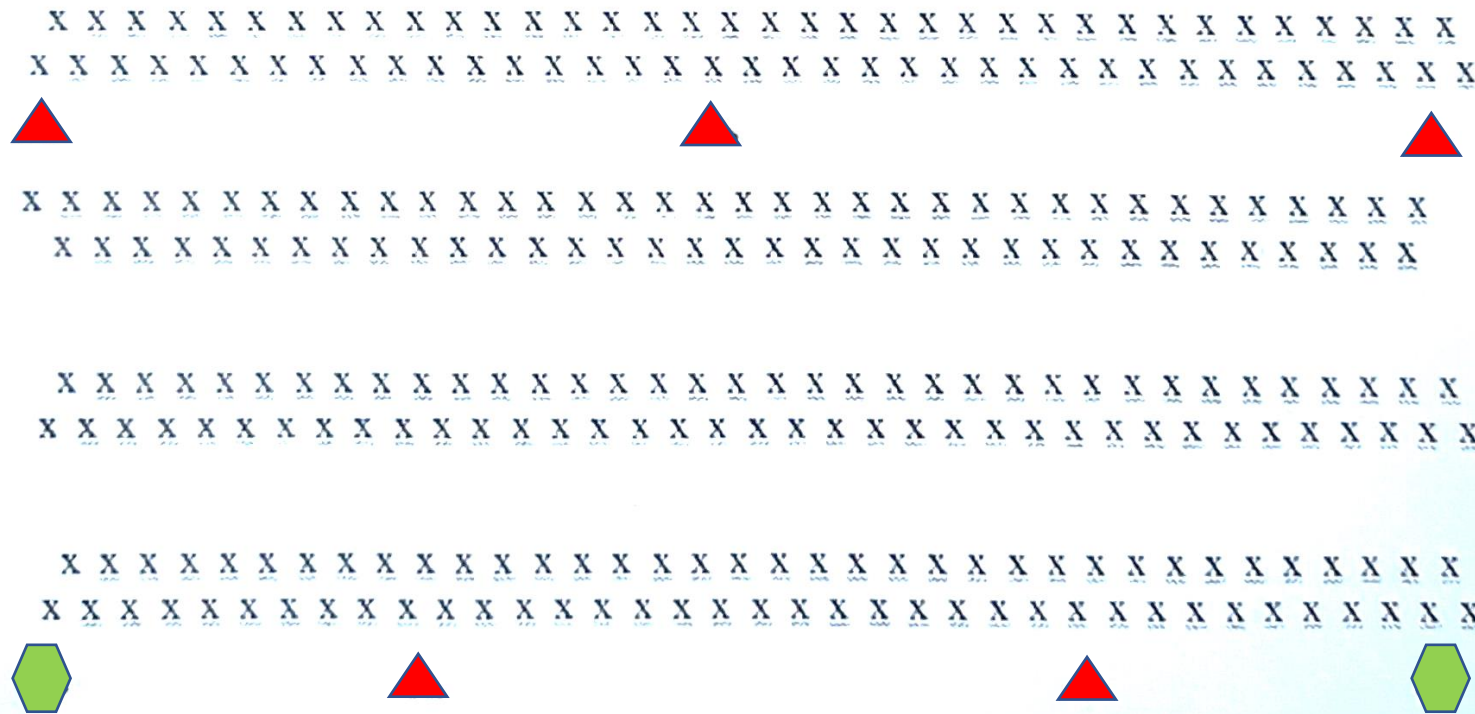
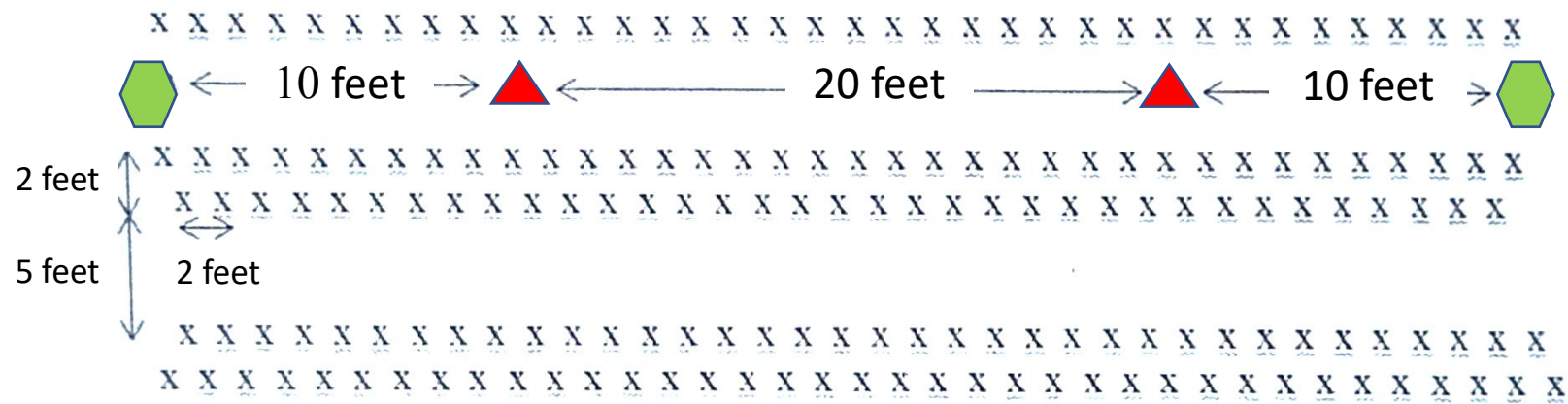




2x2x5 feet

Between tea bushes → 2 x 2 feet  
Between 2 hedge-rows → 5 feet





High shade



Medium shade

x x

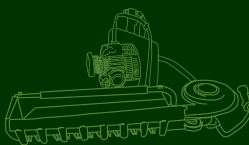
Tea

Medium shade - 20 feet  
(about 250 plants/ha)

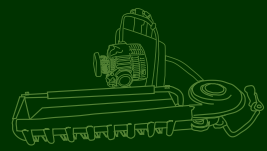
High shade – 40 feet  
(about 60 plants/ha)

Plant in the middle of 5  
feet space btn. double  
hedge-rows

Not in tea rows

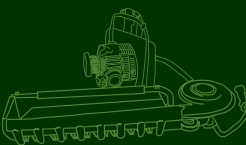
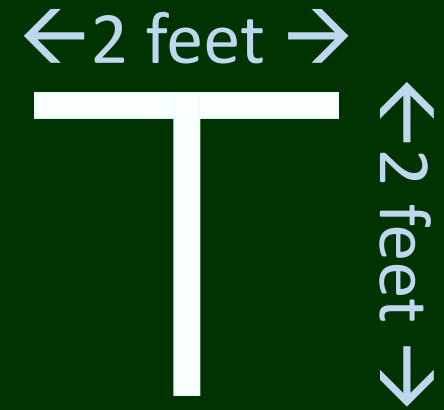








# T - guide for holing



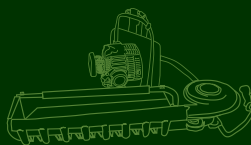






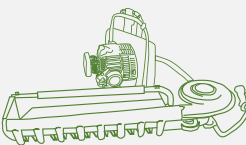
# Important points to note – Double hedge row planting system

- More suitable for flat or slight slopes
  - Soil erosion
- Cover crops / mulch - during tea is young
  - Weed management
- Double hedge rows are not very suitable for (due to high plant density)
  - Poor soils
  - Low water holding capacity
  - Frequent heavy drought areas
  - However, drought tolerant erect type tea cultivars can be used in drought prone areas as recommended by the TRI.
- Apply fertilizer considering bush density (14% more bushes)
- Train bushes accordingly if dome –type harvesters are used.





# Mechanical pruning







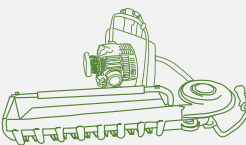
## Manual Pruning

- 250 bushes/day
- Sharp, slant cut
- Cleaning by removing knots dead parts etc.

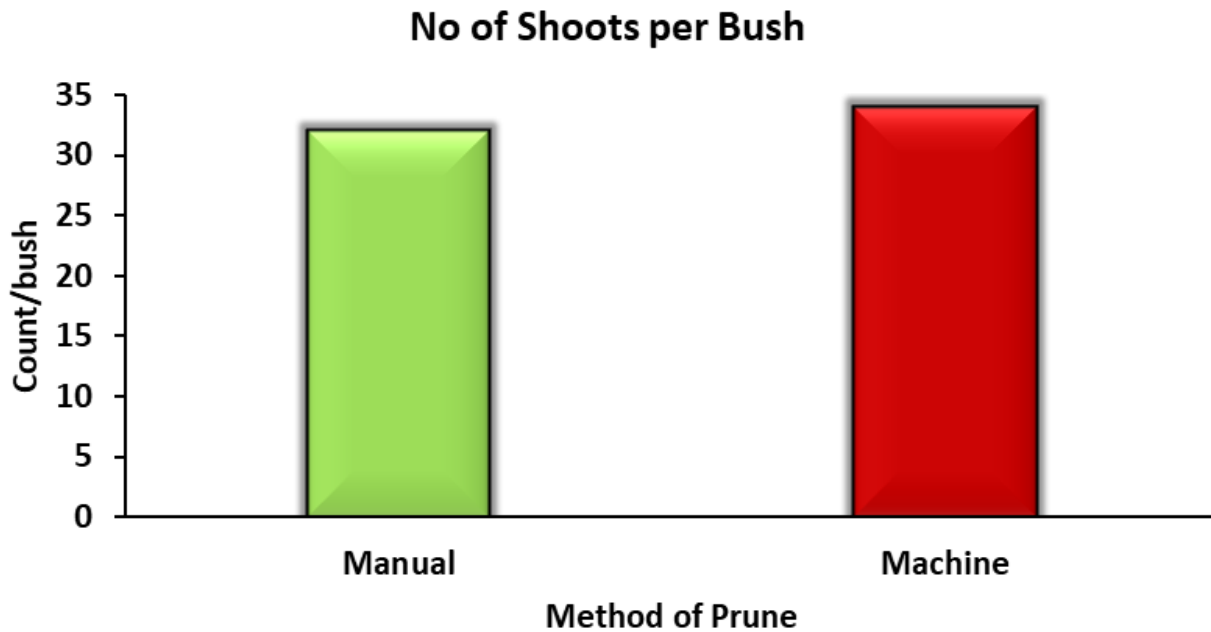


## Mechanical Pruning

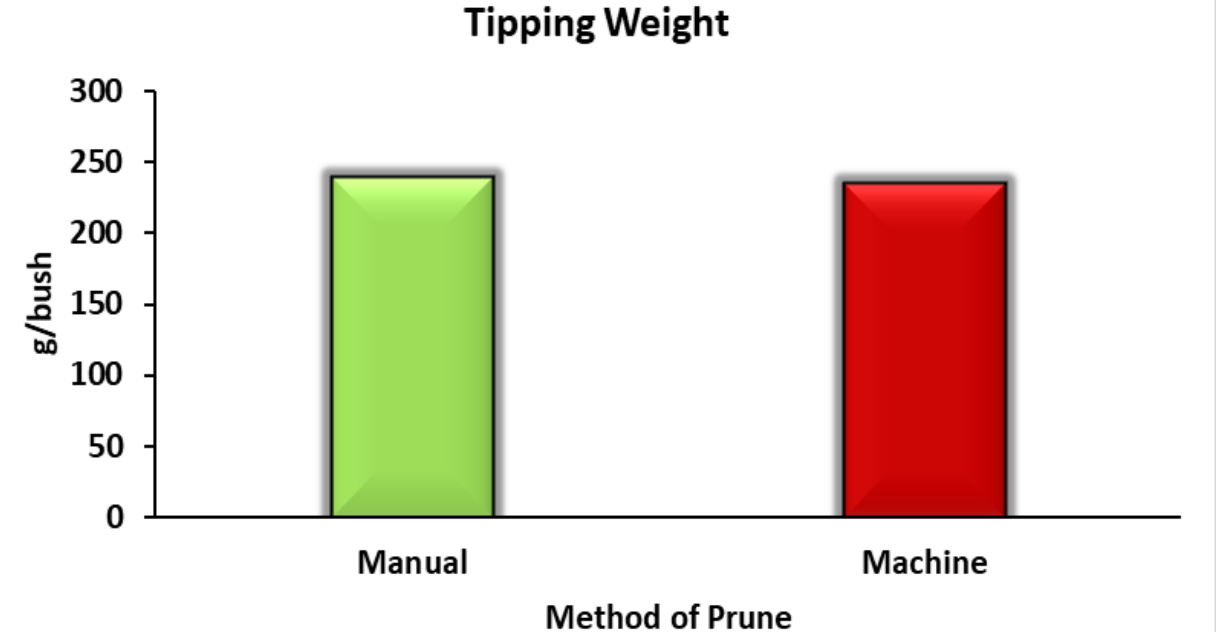
- 1000-1500 bushes/day
- Sharp horizontal cut
- Need separate person to clean with a knife



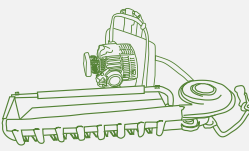
# Experimental Evidences of Recovery After Mechanical Pruning



*Source: Wijeratne et al (2000)*



*Source: Wijeratne et al (2000)*



# Mechanical pruning – Important points to know

- Do not use machines for 1<sup>st</sup> (formative) pruning
  - Formative pruning → well spread healthy frame system
  - Young / thin branches get damaged by the blades

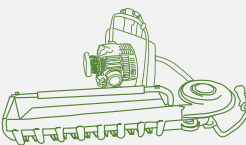
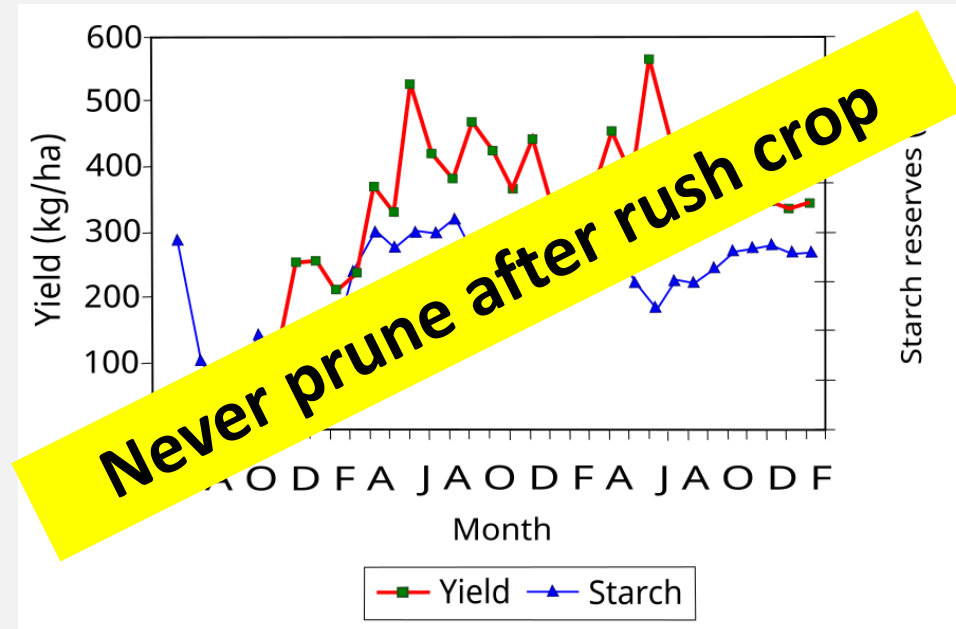
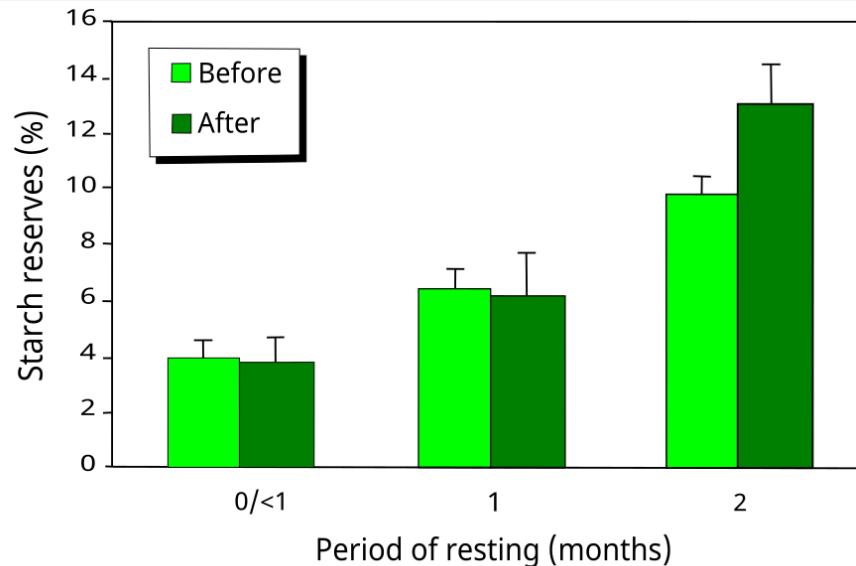
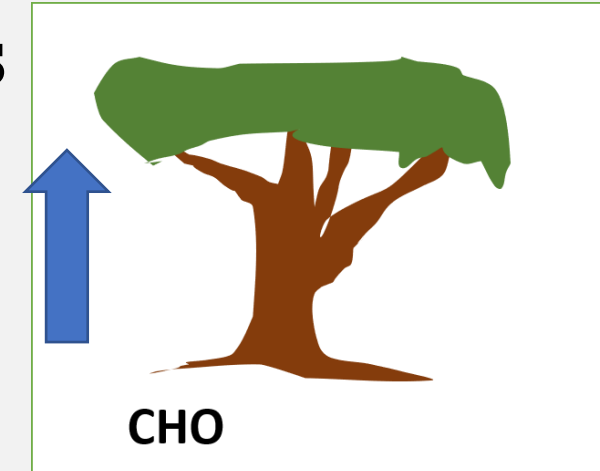




# Mechanical pruning – Imp. points to know cont...

## Field should be rested for a minimum of 6 weeks

- 60% of CHO produced is used for respiration
- Plucking stimulates up-ward movement of CHO
- Recovery after pruning depends on root starch reserves

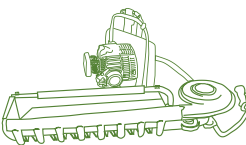


# Mechanical pruning – Imp. points to know cont...

**Rested before pruning**



**Pruned without resting**

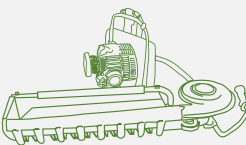




# Mechanical pruning – Imp. points to know cont...

Remove heavily grown weeds, if any

- Entangle with blade
- Damage to machine, operator, tea bush





# Mechanical pruning – Imp. points to know cont...

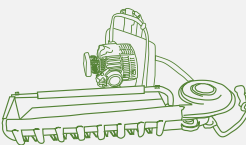
## Use the correct blade speed (throttle)

- Vibration / sound
- Blade stuck inside half-way



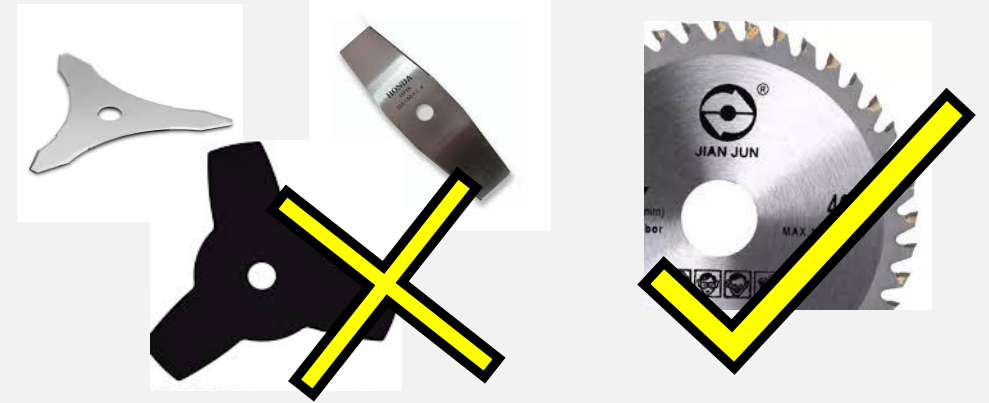
## Never use broken or blunt blades

- Splitting & damaging of cut branches
- Cut surface become rugged
- Reduce the efficiency



# Mechanical pruning – Imp. points to know cont...

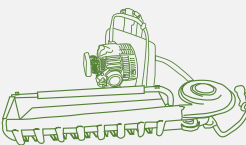
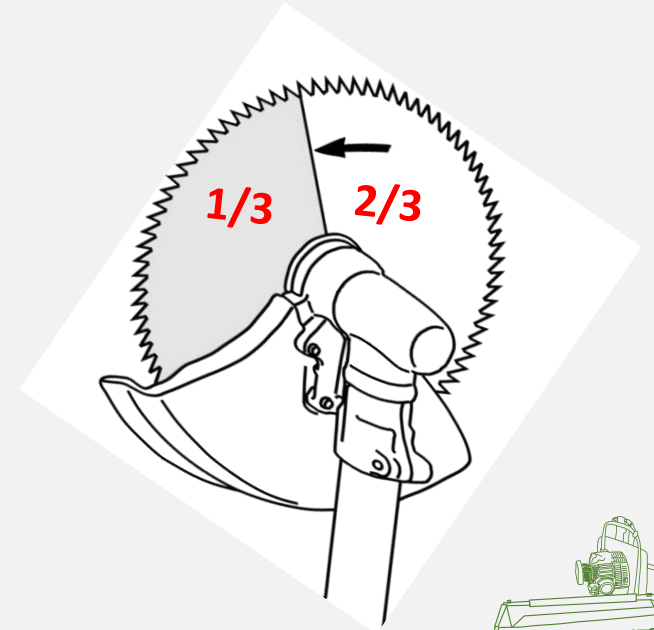
Use a blade with high number of Tungsten/carbon tips (100)



Orientation of tips in blade (when replacing)

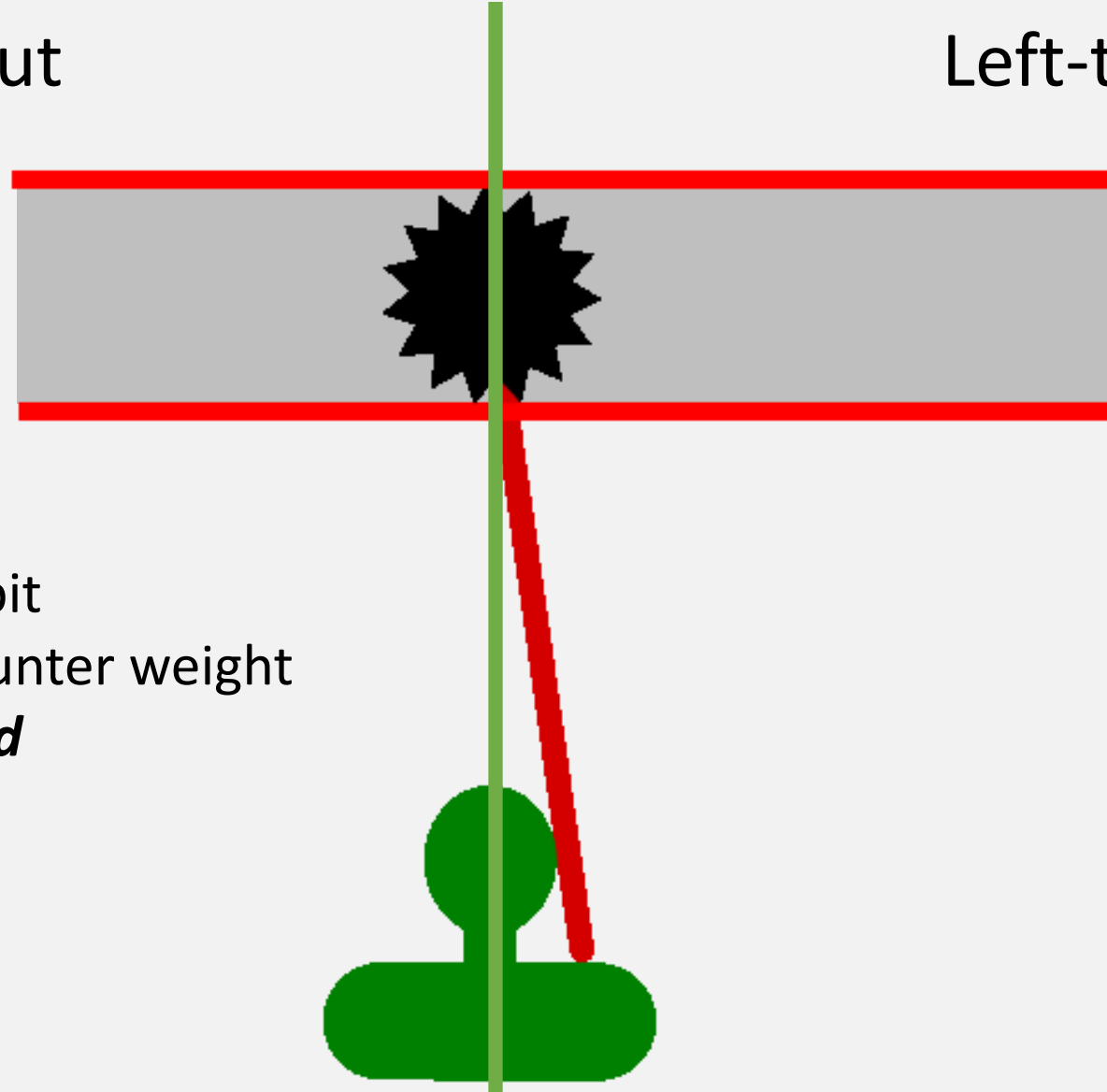
- Anti-clock-wise rotation
- Cutting tips facing left

Left side 1/3 area of blade is more effective

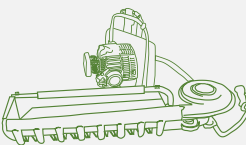


# Right-to-left Cut

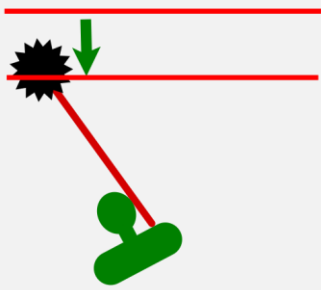
# Left-to-Right Cut



- Blade moves in the orbit
- Operator's body → counter weight
- ***Blade moves backward horizontally***



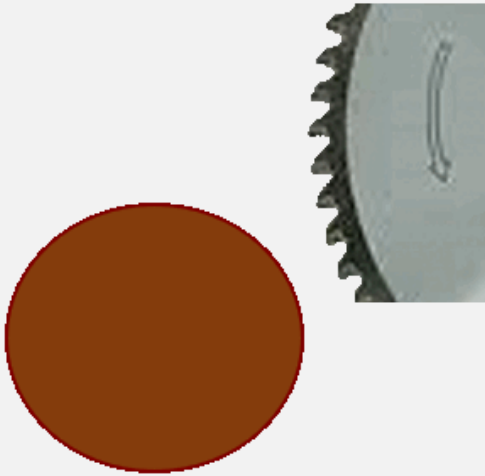




## Right-to-left Cut

Uses left  $\frac{1}{3}$  of the blade

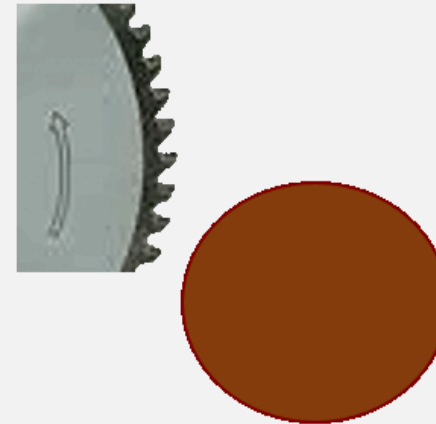
Both horizontal and rotating movements are towards cutting direction of teeth



## Left-to-Right Cut

Uses right side of the blade

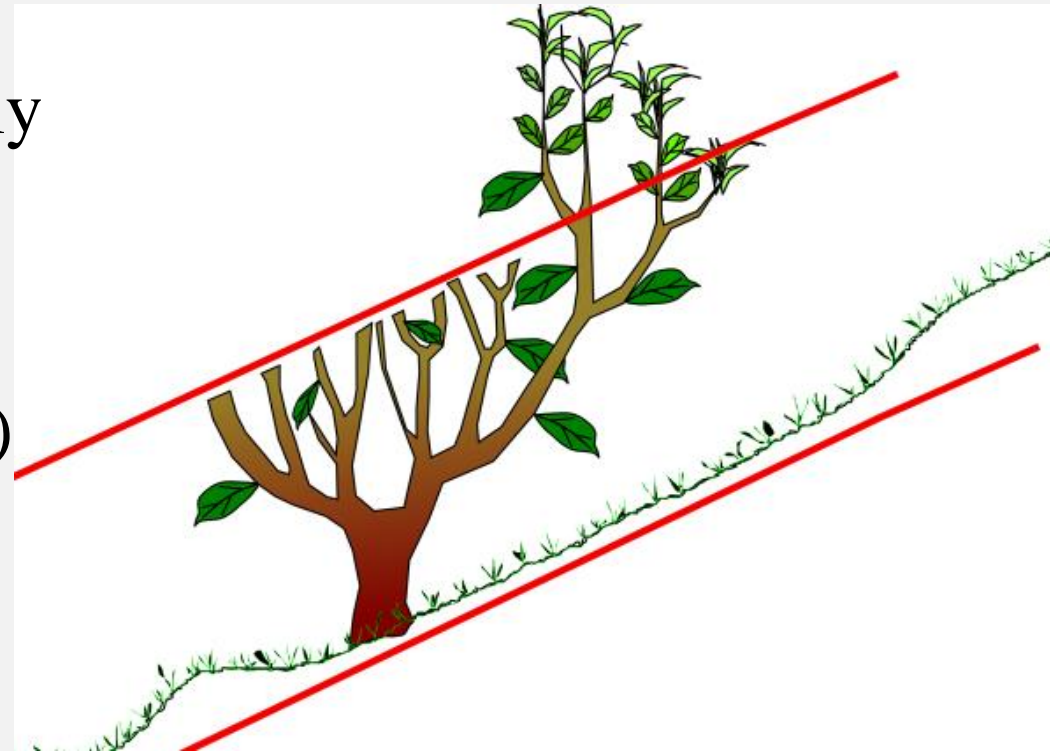
Horizontal movement and cutting direction of teeth are different

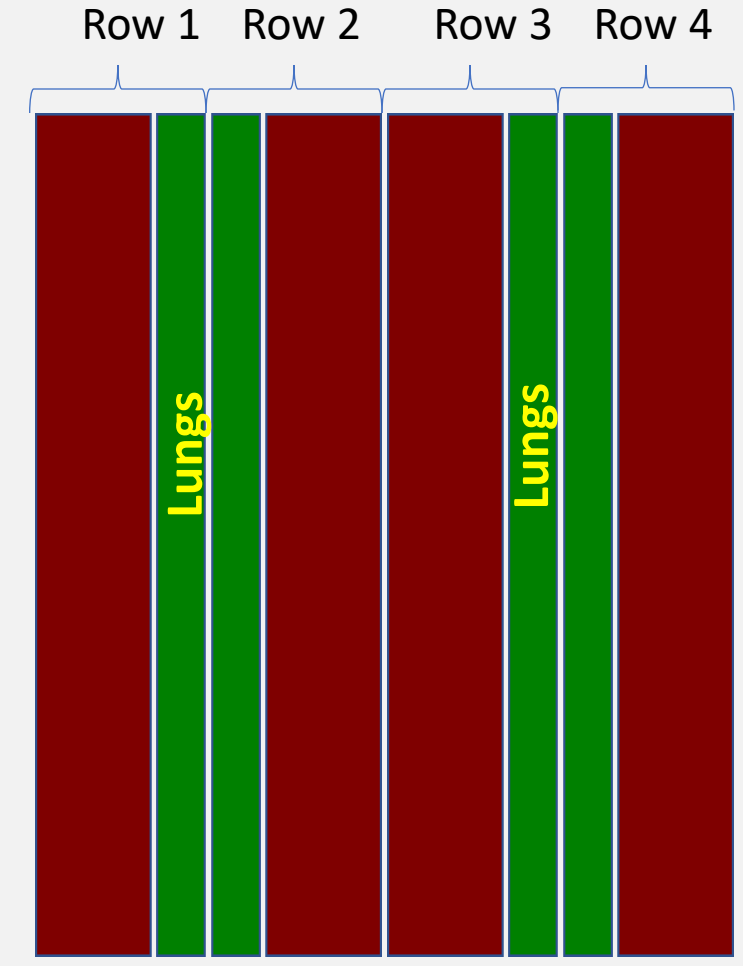
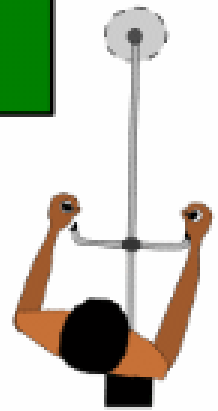
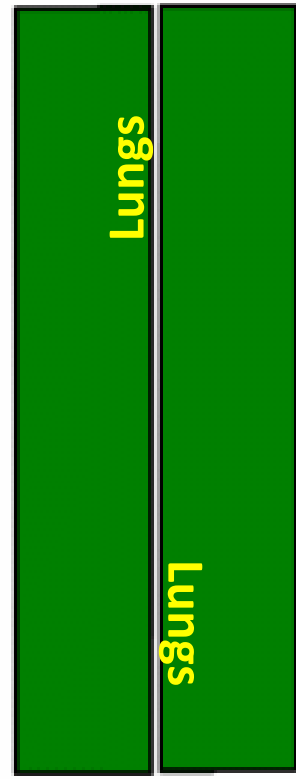


Less Efficient

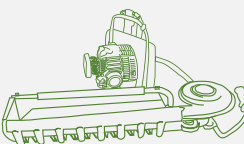
# Using the pruning machine

- First, cut down several branches closer to the operator (use a guid for height)
- Proceed forward and cut the rest of branches
- Never ram/hit into the bush (this is a saw, not a knife)
- Lungs (200-300 leaves) on the left side only
- Cut parallel to the ground
- Use a knife to clean (knots, dead, diseased)





Adequate space for after pruning operations





# Mechanical pruning

## Limitations:

*Difficulty to leave lungs*

*Inconvenient to use on sloping terrains*

*Selective removal of branches not possible*

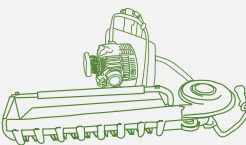
*Can damage the branches (splitting)*

*Frame sanitation not possible*

*Frequent repairs of the machines*

**Not suitable for formative pruning**

**Manual cleaning needs to be undertaken separately**



# Mechanical pruning

## Minimize limitations:

Use correct blades (carbon/tungsten tipped blades)

Adequate throttle / blade speed

Do not hammer the blade against branches

Cut from left side of the blade (Move anti-clockwise)

Apply grease etc and attend services as recommended



# For more information ....

**TEA RESEARCH INSTITUTE OF SRI LANKA**

**Issued in: July 2013**

**Guideline No: 01/13**

**GUIDELINES FOR USE OF MOTORIZED TEA HARVESTING MACHINES**

**TEA RESEARCH INSTITUTE OF SRI LANKA**

**Issued in: July 2009**

**Guideline No: 02/09**

**GUIDELINES FOR USE OF SELECTIVE TEA HARVESTER**

**TEA RESEARCH INSTITUTE OF SRI LANKA**

**Issued In: December 2019**

**Guideline No: 03/2019**

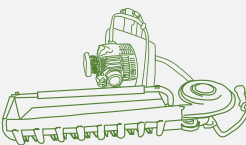
**GUIDELINES FOR ESTABLISHMENT OF TEA TO FACILITATE  
MECHANIZATION OF FIELD OPERATIONS**

**TEA RESEARCH INSTITUTE OF SRI LANKA**

**Issued in: December 2019**

**Guideline No: 02/2019**

**GUIDELINES FOR USE OF MOTORIZED TEA PRUNING MACHINES**







# End

