An Optimal Decision Support Tool For The Split Process In Waxflowers

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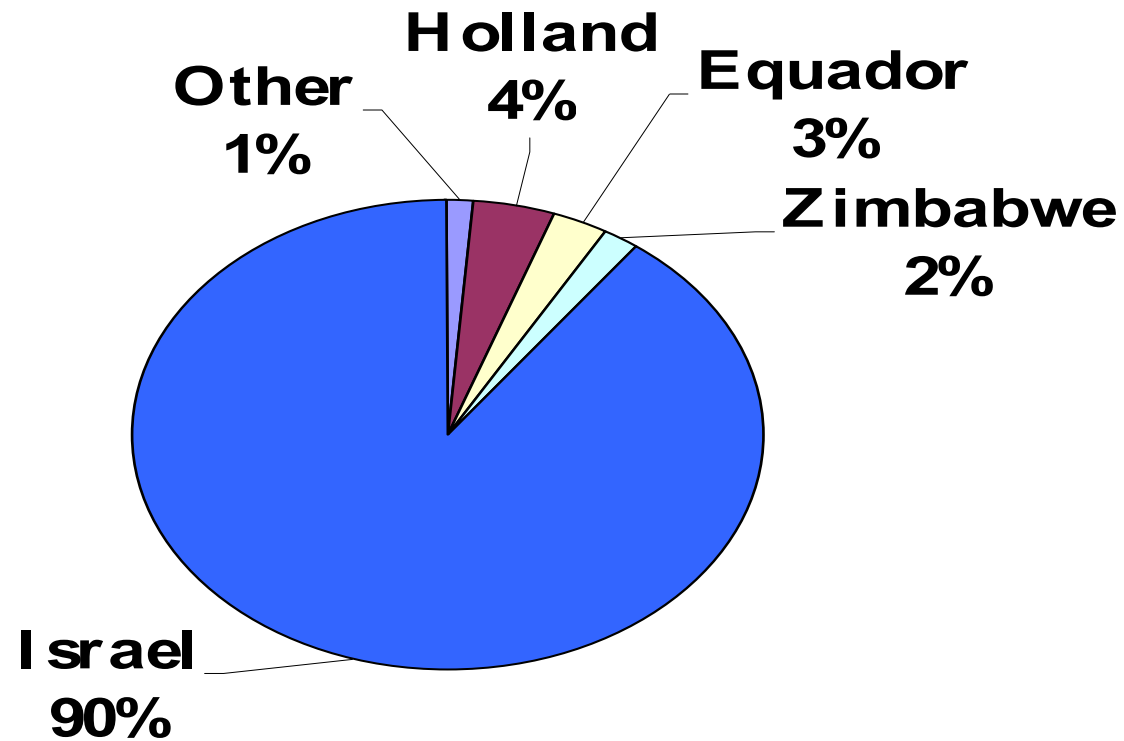[2]Ruppin Academic Center, School of Engineering, Emek-Hefer, Israel

Wax Flowers (*Chamelaucium Uncinatum*) Overview

- **Originates in West Australia, >20 species.**
- **Bouquet filler due to:**
  - ❑ **Long vase life**
  - ❑ **Floral display**
- **Major production areas: Australia, Chile, Israel, Peru, South Africa.**

Sales Distribution in the Dutch Markets

Other 1%
Holland 4%
Equador 3%
Zimbabwe 2%
Israel 90%

Wax Flowers in Israel

- **Grown since 1971.**

- **200 ha for export.**

- **Average annual yield of 350,000 flowers per hectare.**

- **4 branch lengths: 50, 60, 70 and 80 cm.**

Research Objective

Develop an optimal branch splitting/cutting methodology in order to improve the splitting stage and to maximize the total revenue

Farms Data

	Area (ha)	Workers
Farm I	7	8
Farm II	13	15

- **Yield/ha/year - 300,000-400,000**

- **Yield/worker/day – 1,300-1,400**

Operational Processes
Harvesting

- **Using a mechanical saw.**

- **Teams of 2 - 4**
  - **Cutting**
  - **Piling**
  - **Binding**
  - **Loading**

Sorting

1. **Length Sorting-** Split branches to 4 lengths categories; 50,60,70,80 cm.
2. **Create Piles**

Binding

Lengths of 60,70,80 cm

5 batches of 5 stems creating a bundle of 25, using a tying machine.

Wrapping in cellophane bag.

Length of 50 cm

Create bundles of 25 stems.

Work Study & Time Measurement

- Work study were performed by means of: direct measurements and work sampling techniques.

- Time measurements were made using software developed for handheld computers.

Splitting methodology

- 100 raw branches population.

- Determine main splitting combinations.

- Determine all splitting combinations using Matlab.

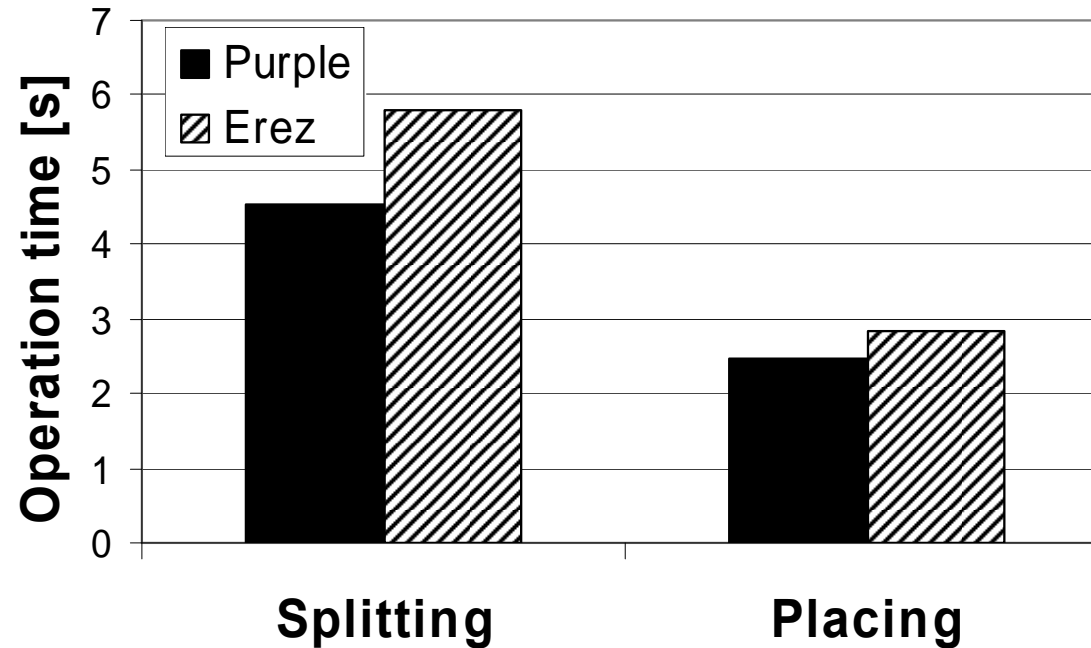- Develop operational profit function.

- Sensitivity analysis.

RESULTS

Splitting distribution - current
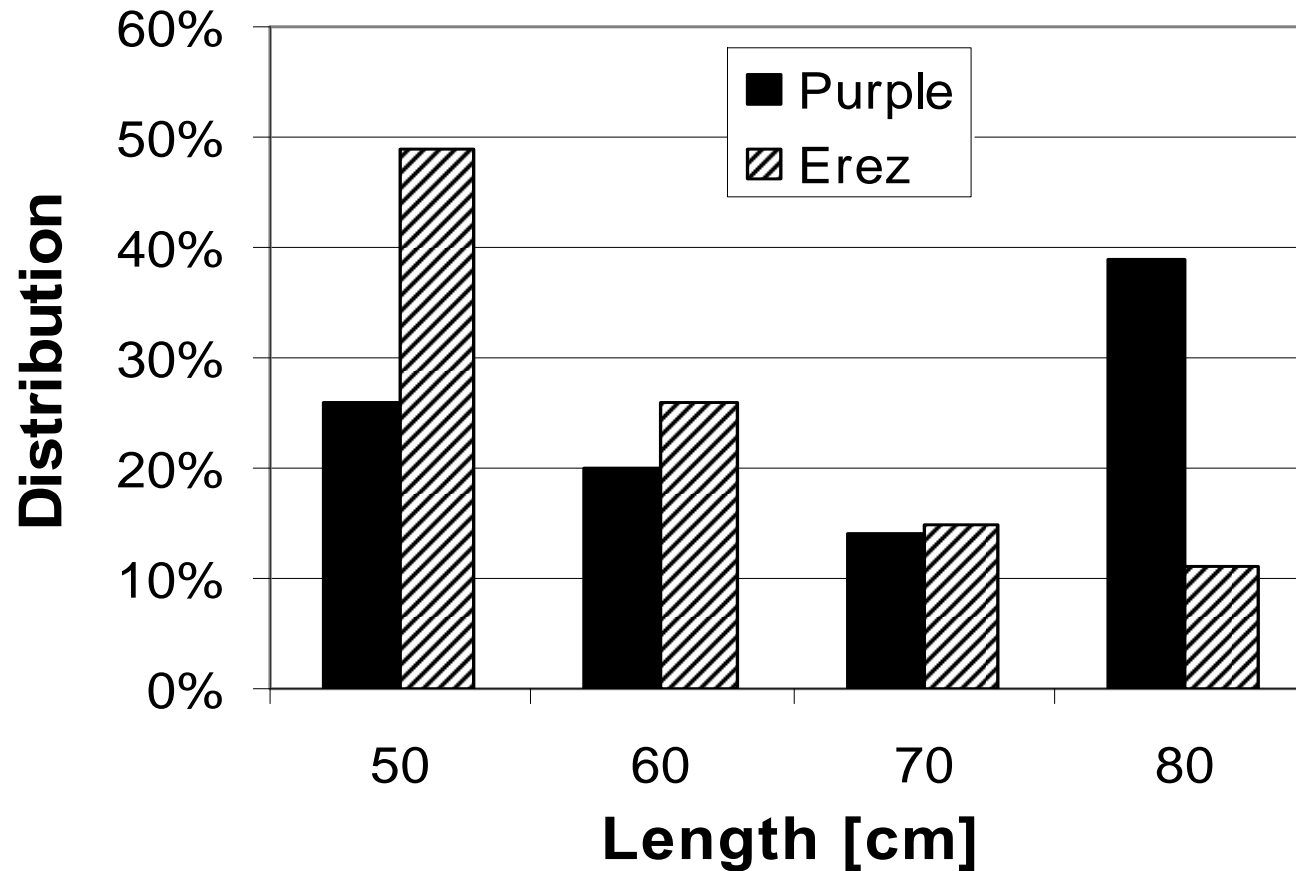
influenced by the plant life cycle in the plot, worker's splitting abilities, farmer's marketing strategy.

Splitting time - current

Erez cultivar requires 27% and 14% more time than the Purple cultivar for splitting and length sorting operations.

Main splitting combinations

	Combination 1				Combination 2				Combination 3			
	80	**70**	**60**	**50**	**80**	**70**	**60**	**50**	**80**	**70**	**60**	**50**
1	1						2	1		1	1	
2	1					1	1					
3	1		2			1	2	1				
4	1						1	1				
5		1										
6	1											
7	1		1									
8	1					2				1	1	1
9		2										
10	2				1	1		1	1		2	1

Operational profit function

$$R = Max \left[\sum_{i=1}^{4} Q_{ij} \cdot \left[P_i - \left(Mc_i + Sc_i + Bc_i \right) \right] \right]_{j=1}^{n}$$

- P_i – sell price of one branch (revenue)
- Q_{ij} – quantity
- Mc_i – manufacturing cost
- Sc_i – shipment cost
- Bc_i – Bourse cost
- i – size category index
- j – Combination

Manufacturing cost

Size category	80	70	60	50
Labor cost [€]	0.023	0.023	0.022	0.022
Fixed cost [€]	0.026	0.026	0.026	0.026
ROI [€]	0.008	0.008	0.008	0.008
Total [€]	0.055	0.055	0.054	0.054

Costs, revenue, profit

Size category	Manuf. cost	Ship. cost	Bourse cost	Total costs	Revenue	Operational profit
80	0.055	0.080	0.012	0.147	0.221	0.075
70	0.055	0.047	0.008	0.110	0.144	0.034
60	0.054	0.026	0.004	0.084	0.094	0.009
50	0.054	0.017	0.003	0.075	0.078	0.003

* All figures in €

Current strategy
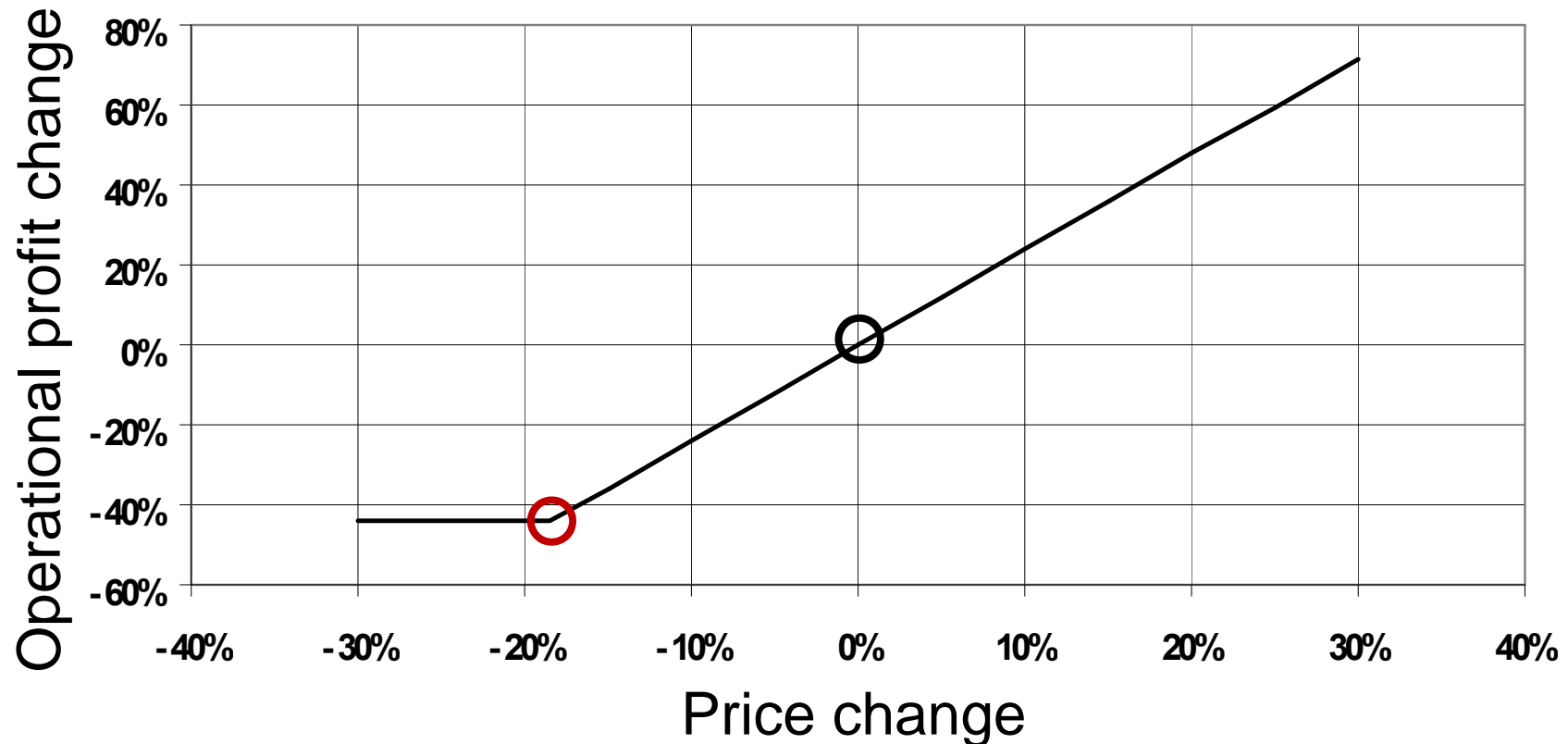
- The current strategy is to maximize branches length
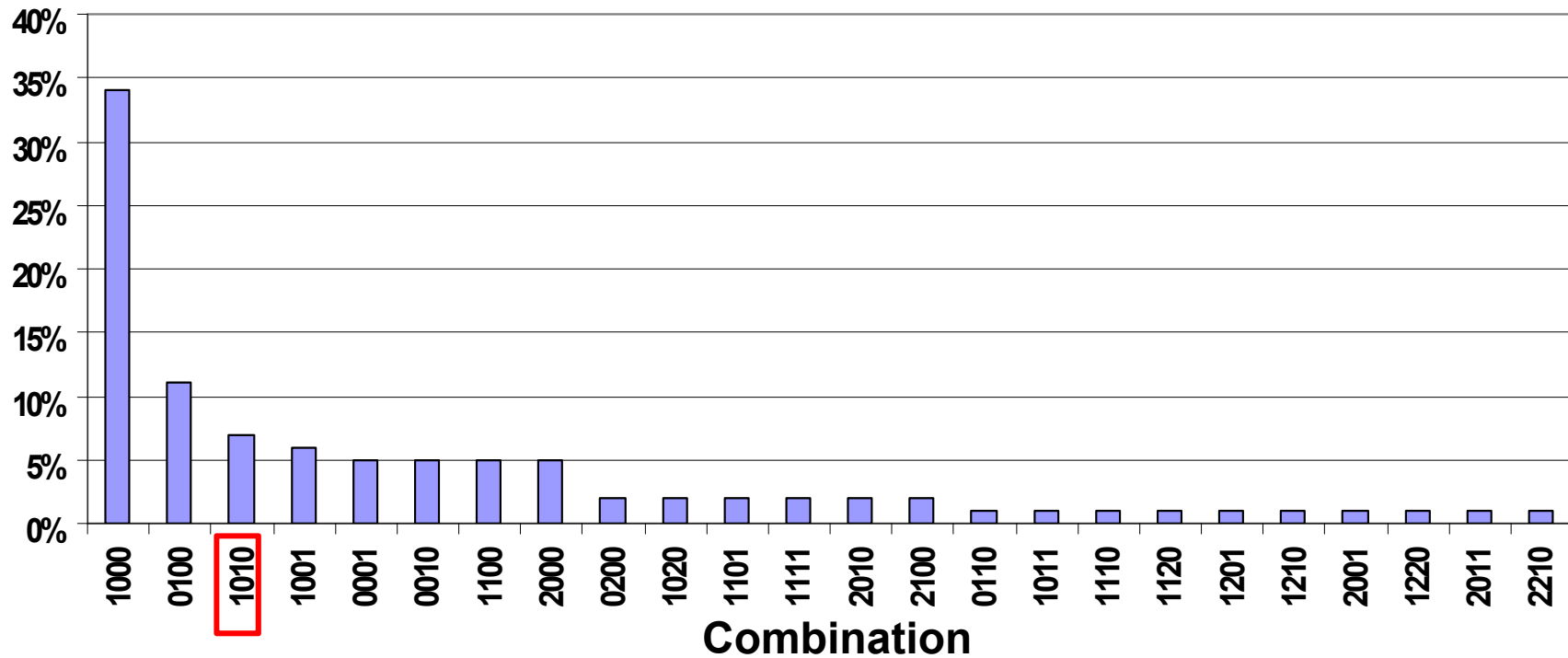
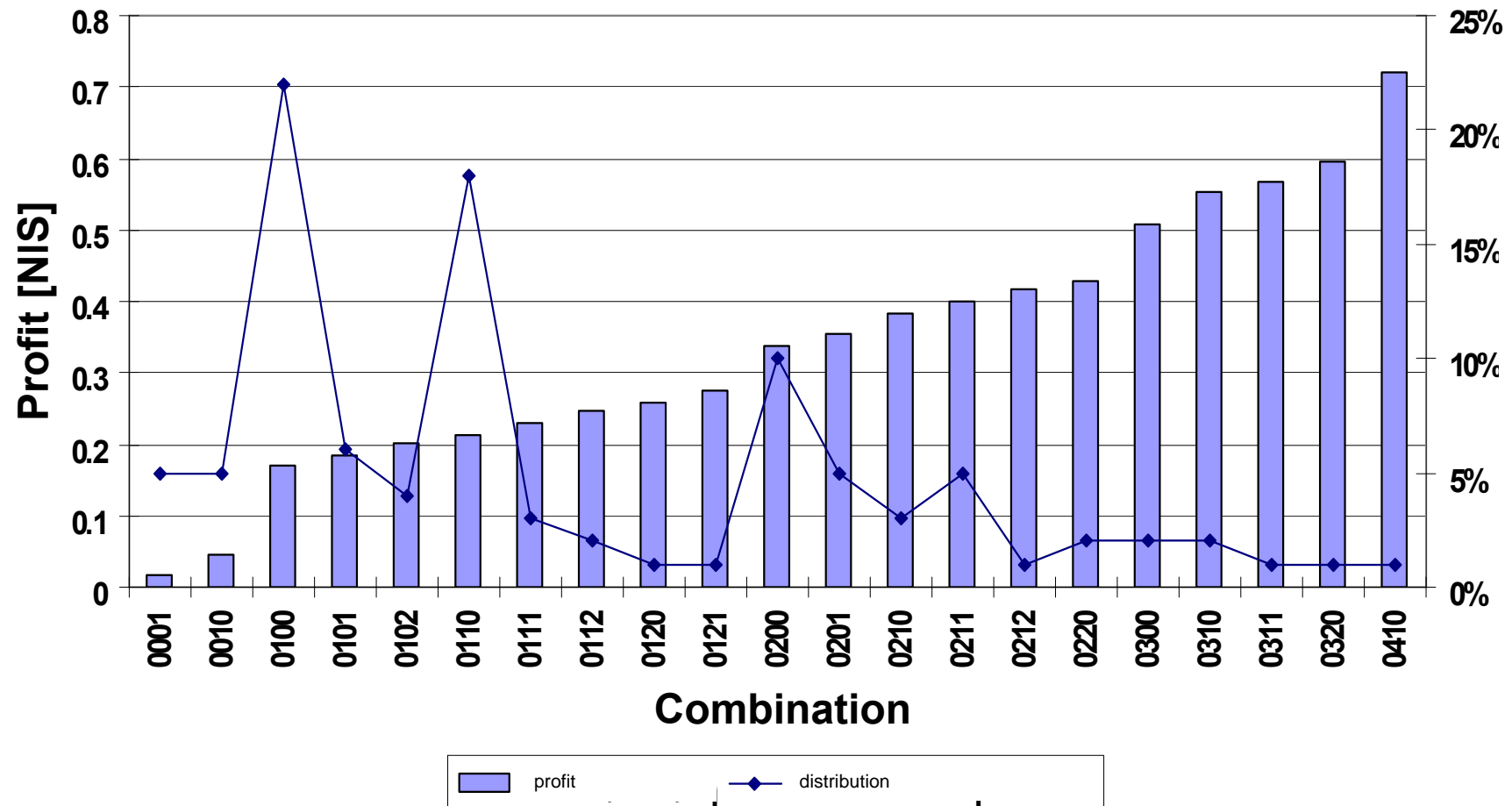| 80 cm	70 cm	60 cm	50 cm
1	**0**	**1**	**0**

Current strategy
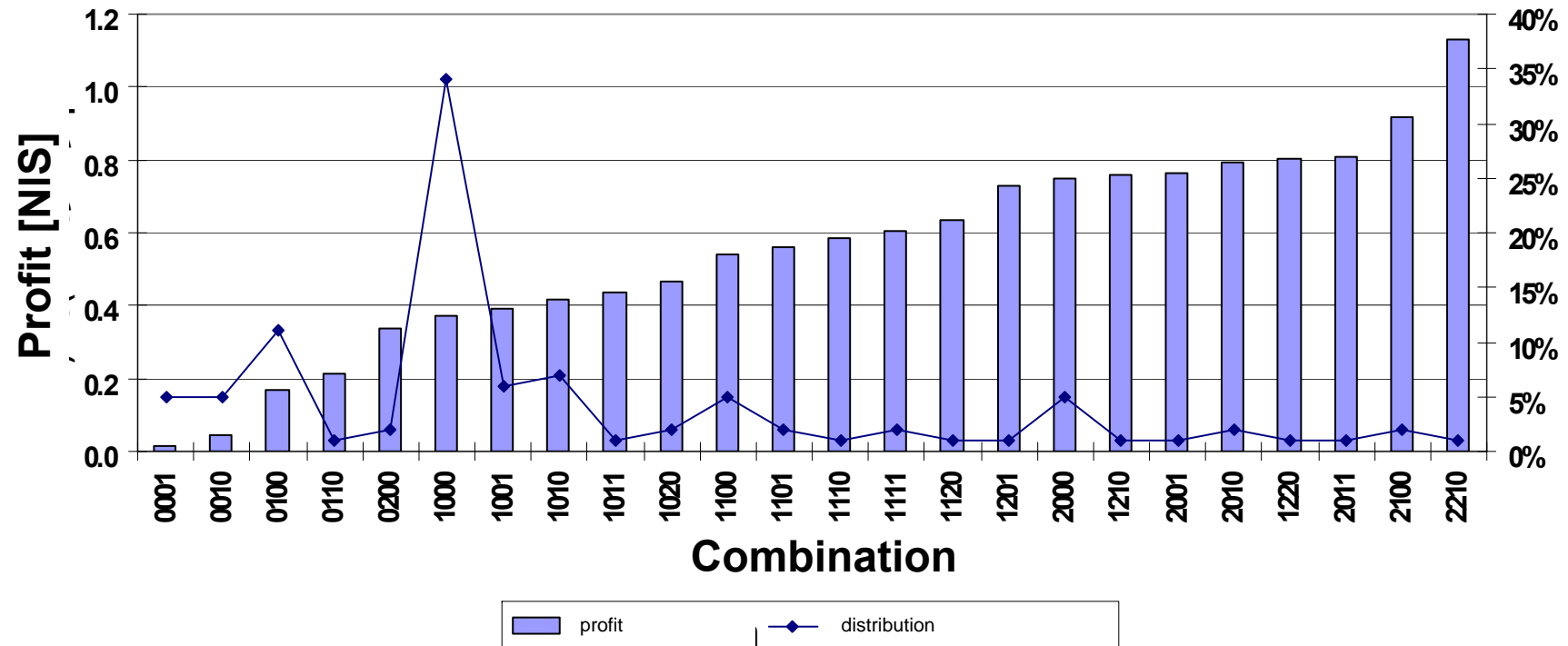
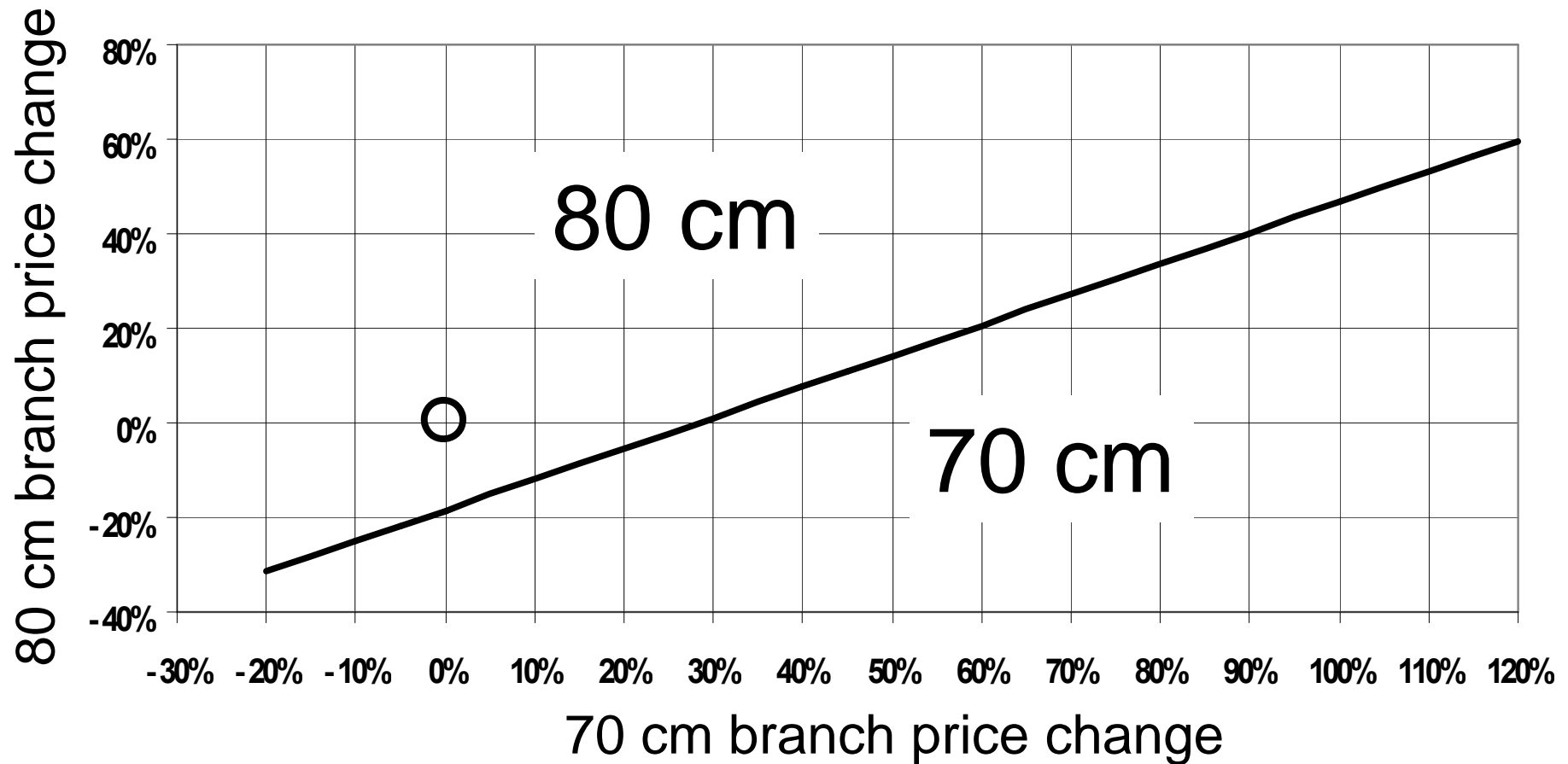# Sensitivity analysis - 80 cm branch

The influence of 80 cm branch price on the operational profit

Sensitivity analysis - 80 cm branch

Sensitivity analysis–transition curve

Summary and Conclusions

- The splitting strategy can influence the total operational profit of the same raw material.

- An operational profit function was developed to evaluate the optimal splitting strategy.

- The splitting methodology will allow the farmer to determine the optimal splitting strategy for each scenario.

THANK YOU

Questions?

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