# Shifting flowering time of *Protea cynaroides* for increased market access

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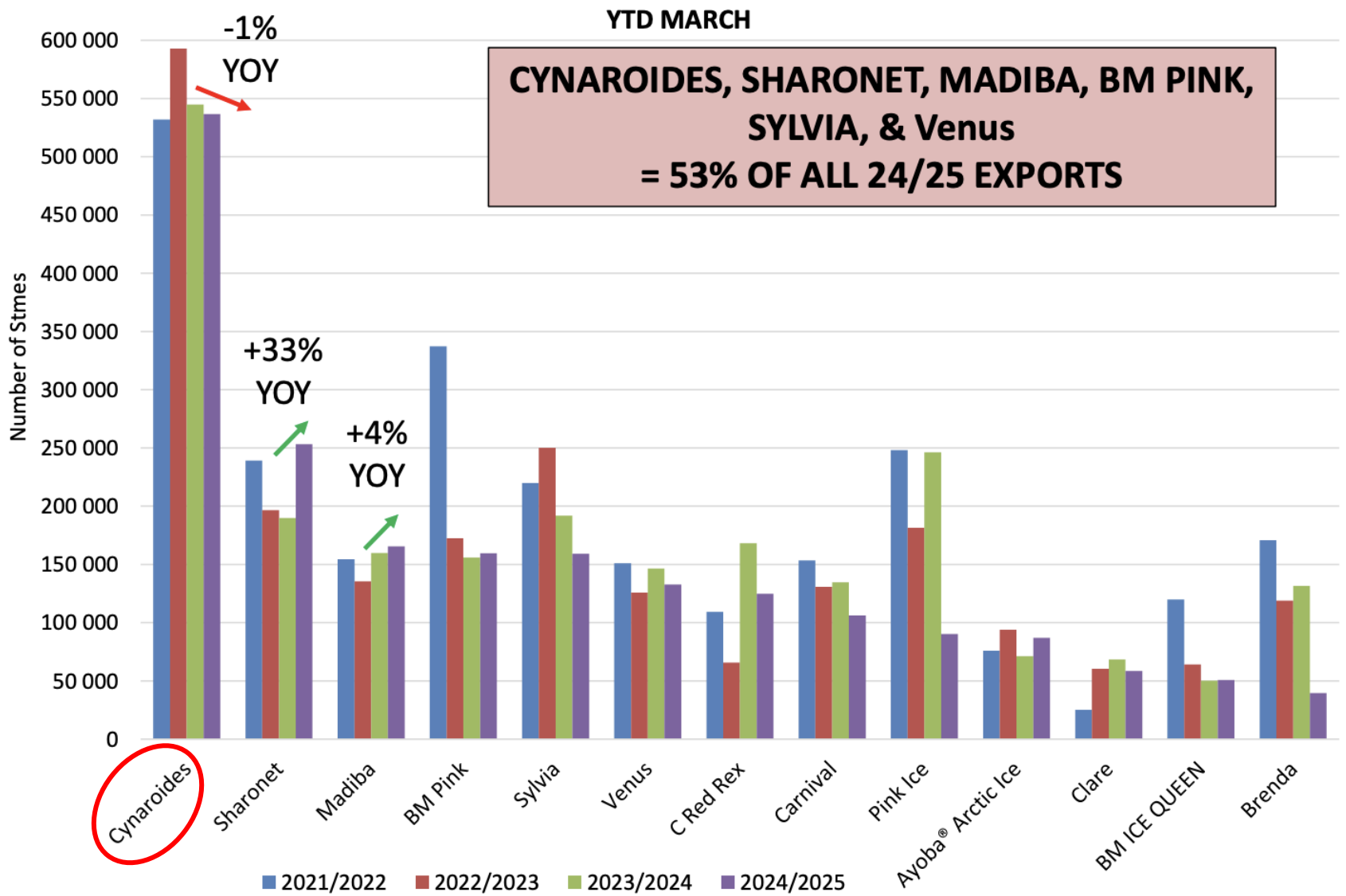
# Overview

- King Protea
- Iconic species in the Proteaceae family
- South Africa's national flower
- Native to the Cape Floristic region
- Beautiful, large, striking flower heads
- Mediterranean climate
- Nutrient-poor soils

# Demand

- Emphasis on exporting of *Protea*
- Europe primary market
- Seasonal variations in supply and demand
- Influenced by market trends in the Northern Hemisphere
- Peak of cultivated *Protea* demand -Europe's autumn and winter seasons, September to February
- October: Market flooded with King Proteas from South Africa

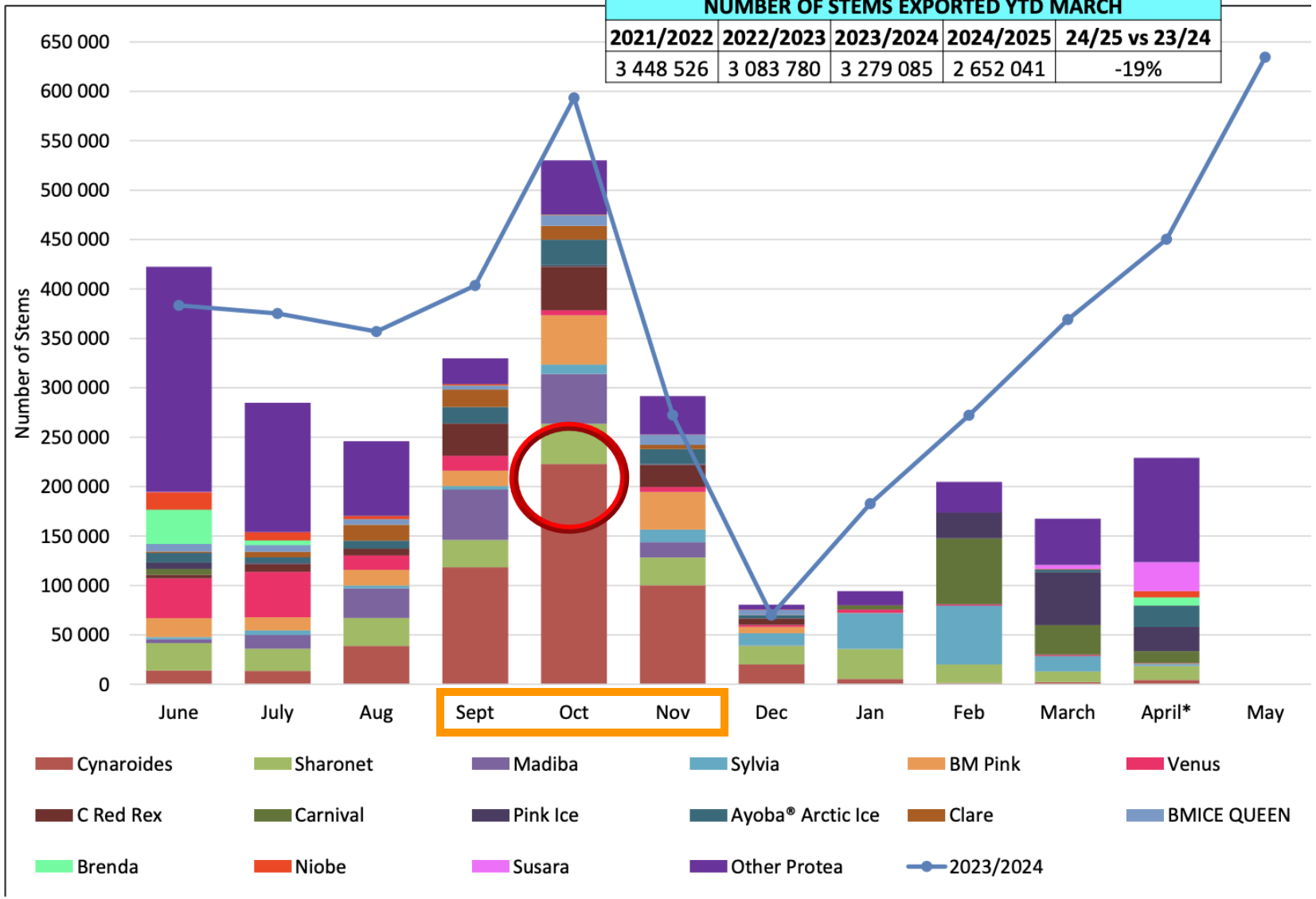
# Protea Exports: 4 year comparison




(Viljoen, 2025)

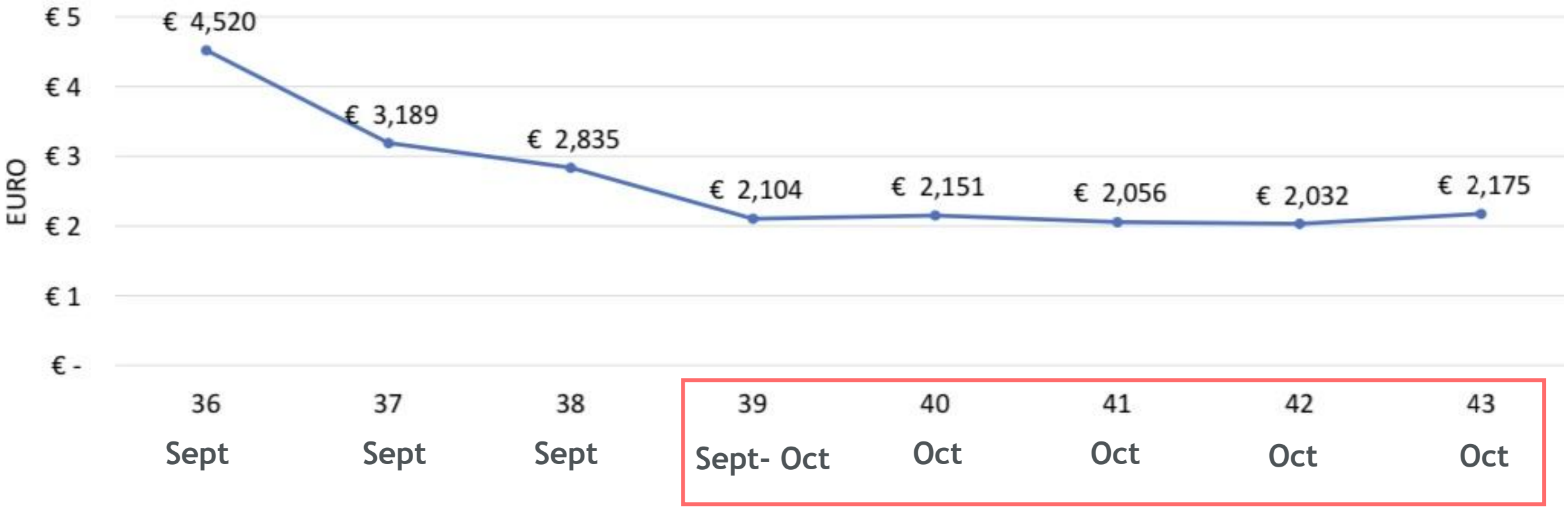
# Protea: 2024/2025 Exports

| NUMBER OF STEMS EXPORTED YTD MARCH | | | | |
|---|---|---|---|---|
| 2021/2022 | 2022/2023 | 2023/2024 | 2024/2025 | 24/25 vs 23/24 |
| 3 448 526 | 3 083 780 | 3 279 085 | 2 652 041 | -19% |

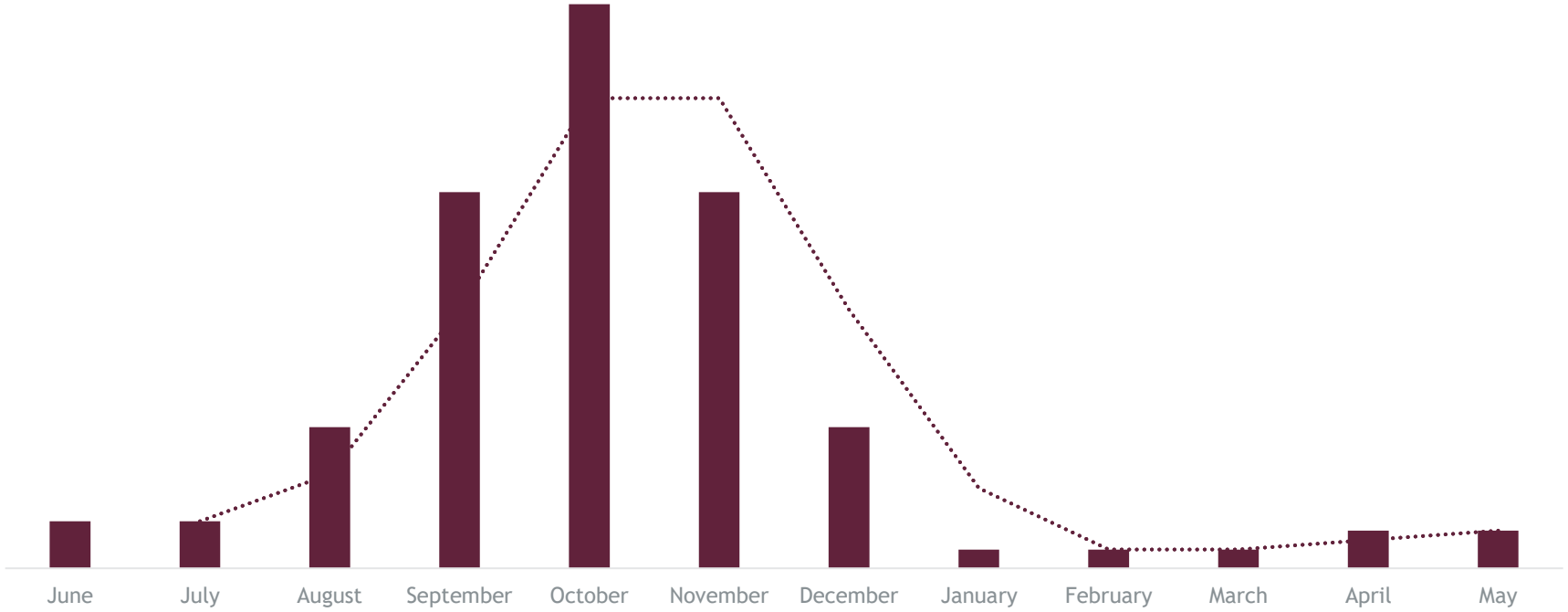


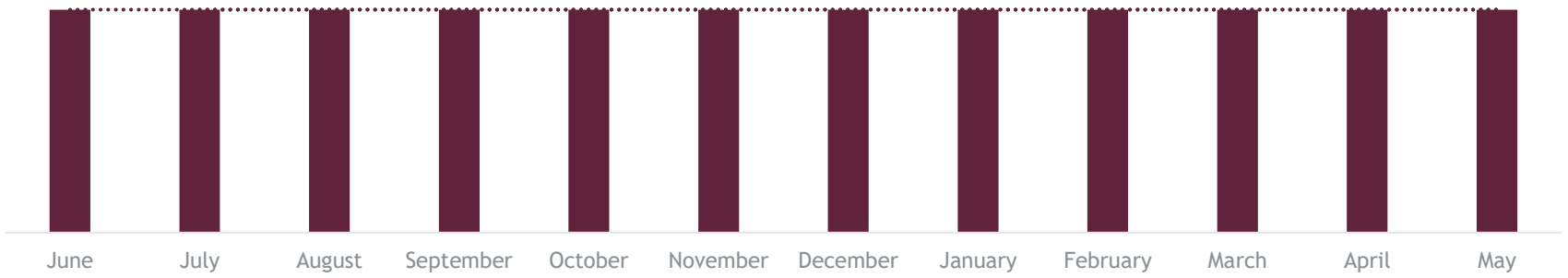

(Viljoen, 2025)

# Price per *Protea cynaroides* stem at Dutch Auction 2022



# Importance of flowering time



# Factors influencing flowering

- Temperature
- Genetic factors
- Carbohydrates
- Stem quality
- Water stress
- Pruning
- Plant growth regulators

# Stem quality

- Meristem surface area
- Thinner shoots = longer development
- Thicker shoots = initiate flowers earlier
- Minimum shoot diameter

# Chapter 1

## Manipulating flowering time of *Protea cynaroides* in a synchronised system, by using Plant Growth Regulators

# Objectives

1

Test influence of PGRs on flowering time.

2

Determine the best PGRs for earlier/later flowering.

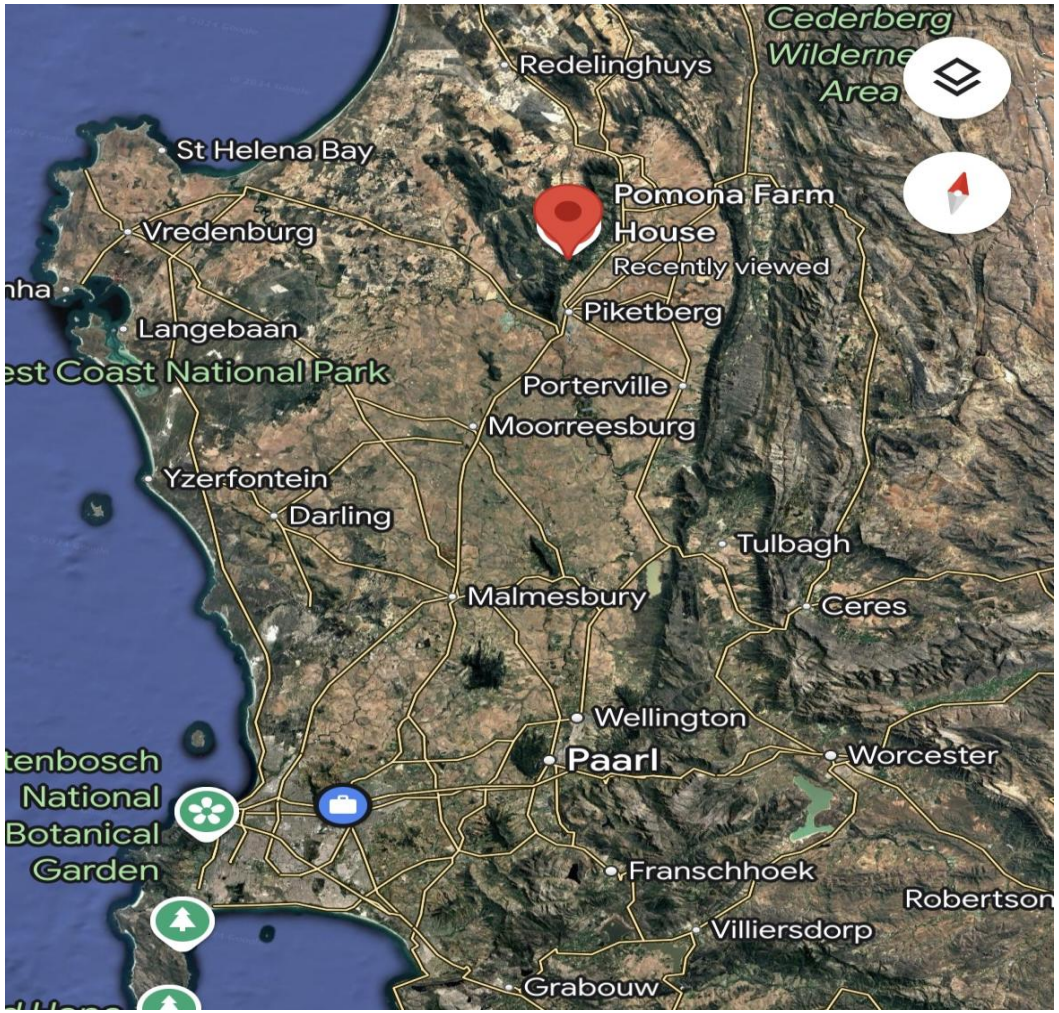
3

Monitor growth and phenological development.

# Plant Growth Regulators (PGRs) and Flowering Manipulation

- Synthetic compounds
- Used in horticulture to shift flowering time
- 6-BA (Cytokinin)
- 6-BA + GA
- Uniconazole (GA inhibitor)
- Ethephon

# Materials and Methods



# Materials and Methods

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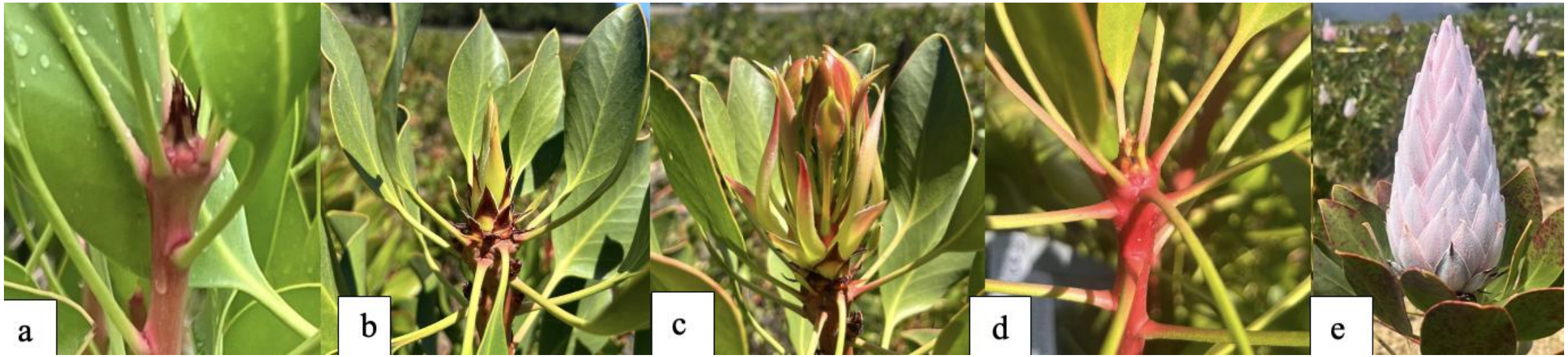
**2025 Treatments**

| Treatment | Description |
|---|---|
| 1 | Control |
| 2 | 1000ppm Maxcel 2nd and 3d flush |
| 3 | Ethephon 2nd flush |
| 4 | Ethephon 2nd and 3d flush |
| 5 | Uniconazole 2nd and 3d flush |

**2026 Treatments**

| Treatment | Description |
|---|---|
| 1 | Control |
| 2 | 2000ppm Maxcel 3d flush |
| 3 | Ethephon untreated |
| 4 | Ethephon untreated |
| 5 | Uniconazole drenched |

# Materials and Methods



# Results: Flush Progression for the Pruned System

| Control 1 | Feb | April | Sept |
|---|---|---|---|
| 2 | 100,00% | 27,78% | 5,56% |
| 3 | 0,00% | 72,22% | 94,44% |
| 4 | 0,00% | 0,00% | 0,00% |
| F | 0,00% | 0,00% | 0,00% |
| **Maxcel 2** | | | |
| 2 | 100,00% | 11,11% | 0,00% |
| 3 | 0,00% | 88,89% | 5,56% |
| 4 | 0,00% | 0,00% | 77,78% |
| F | 0,00% | 0,00% | 16,67% |
| **Ethephon 3** | | | |
| 2 | 100,00% | 50,00% | 13,89% |
| 3 | 0,00% | 50,00% | 86,11% |
| 4 | 0,00% | 0,00% | 0,00% |
| F | 0,00% | 0,00% | 0,00% |
| **Ethephon 4** | | | |
| 2 | 100,00% | 13,89% | 0,00% |
| 3 | 0,00% | 86,11% | 100,00% |
| 4 | 0,00% | 0,00% | 0,00% |
| F | 0,00% | 0,00% | 0,00% |
| **Uniconazole 5** | | | |
| 2 | 100,00% | 55,56% | 5,56% |
| 3 | 0,00% | 44,44% | 94,44% |
| 4 | 0,00% | 0,00% | 0,00% |
| F | 0,00% | 0,00% | 0,00% |

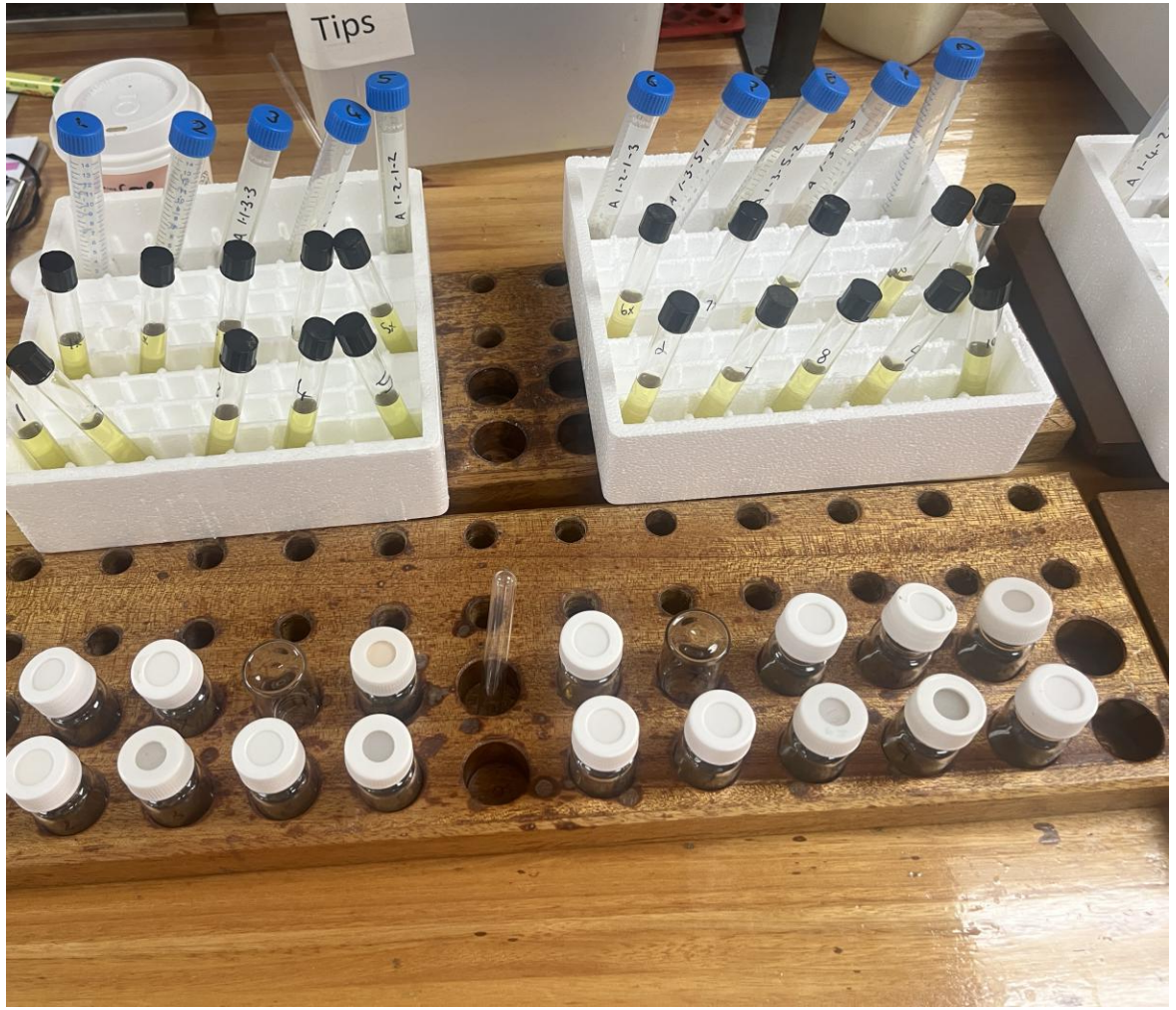
# Anticipated Outcomes

Identify PGRs that:

- Advance flowering
- Delay flowering
- Improve flowering quality & yield
- Offer grower strategies for market timing

# Chapter 2

## Carbohydrate Dynamics in Relation to the control of flowering in *Protea cynaroides*



# Overview of Carbohydrates in *Protea*

- Flowering relies on non-structural carbohydrates (NSCs)
- Leaves = key carbohydrate reserves
- Larger shoots → more leaves → more dry mass → earlier flowering
- Defoliation = negative
- Seasonal NSC buildup is important
- Flowering depends on shoot maturity + NSC levels
- High polysaccharides → flowering; simple sugars → vegetative growth

# Objectives

1

Investigate carbohydrate dynamics in *Protea cynaroides* during key phenological stages.

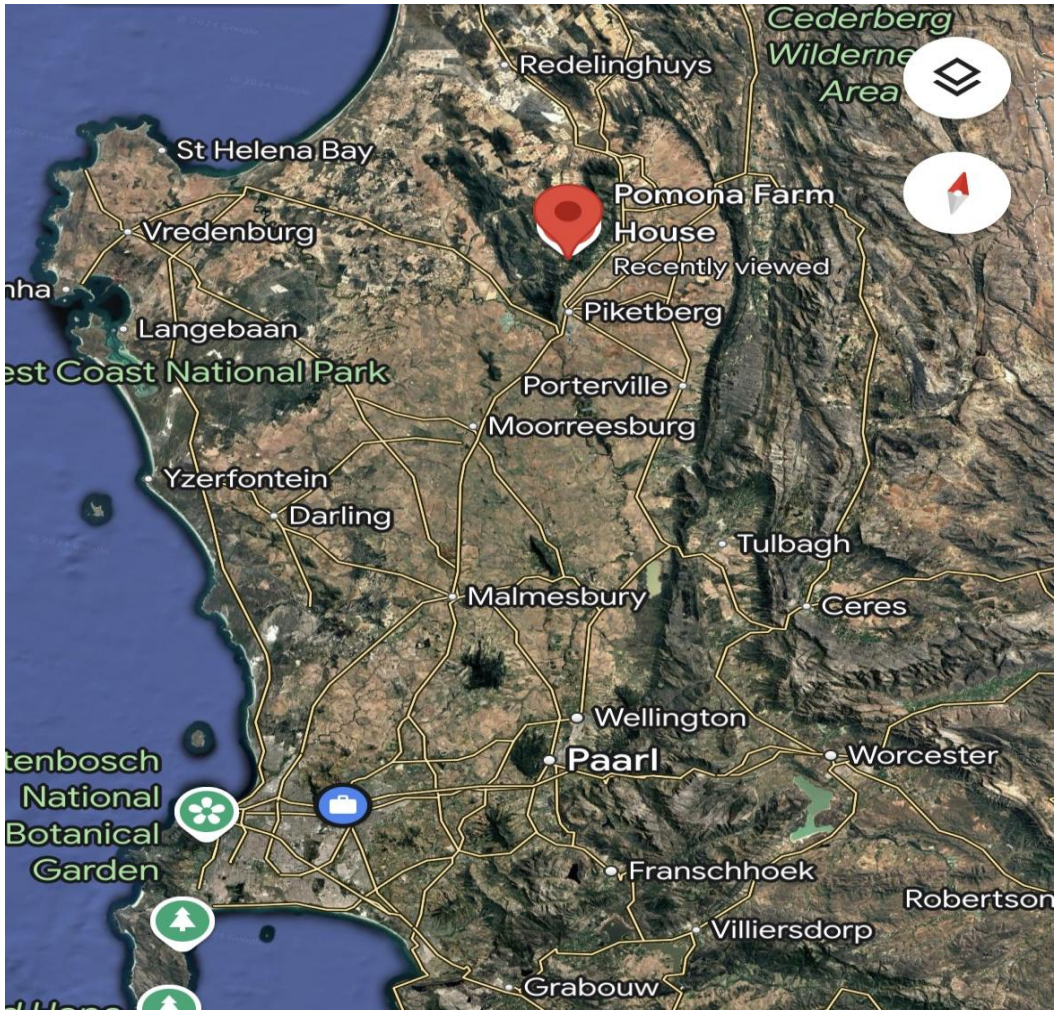
2

Assess the role of NSCs in floral initiation and development.

3

Evaluate the impact of shoot maturity on carbohydrate allocation and flowering.

# Materials and Methods



# Materials and Methods: Sample Preparation

⚖️ Fresh weight

↓

📏 Leaf area ($cm^2$)

↓

🥶 Freeze-dried (24 hrs)

↓

⚖️ Dry weight

↓

⚙️ Milled into fine powder

↓

🗃️ Stored at room temperature until analysis

# Materials and Methods: Carbohydrate Extraction

🧴 **Ethanol Extraction (80°C, x2- 30min ; x1- 20 min)**
→ Mono- & oligosaccharides

💧 **Water Extraction (80°C, 23h, 24h, 21h)**
→ Water-soluble polysaccharides

🔬 **AMG Digestion (100°C, overnight)**
→ Starch hydrolysis (5 mM acetate buffer, pH 4.8)

🧪 Three-Phase Extraction Protocol (0.1 g powdered sample × 3 replicates)

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# Materials and Methods: Quantification

🎯 **Phenol-Sulphuric Acid Assay**

📏 Carbohydrates as **glucose equivalents**

🔬 Standardized **dilutions** for 480 nm absorbance range

# Anticipated outcomes

- Determine patterns of NSC distribution in relation to flowering.
- Identification of shoot flush thresholds linked to inflorescence initiation.
- Determine if different PGRs affect NSC content.
- Insights to improve flowering control and align harvests with market demand.

# Chapter 3

## The effect of Plant Growth Regulators on flowering time of *Protea cynaroides* in commercial, unpruned systems

# Objectives

1

Evaluate the effect of different PGRs under unpruned, commercial conditions.

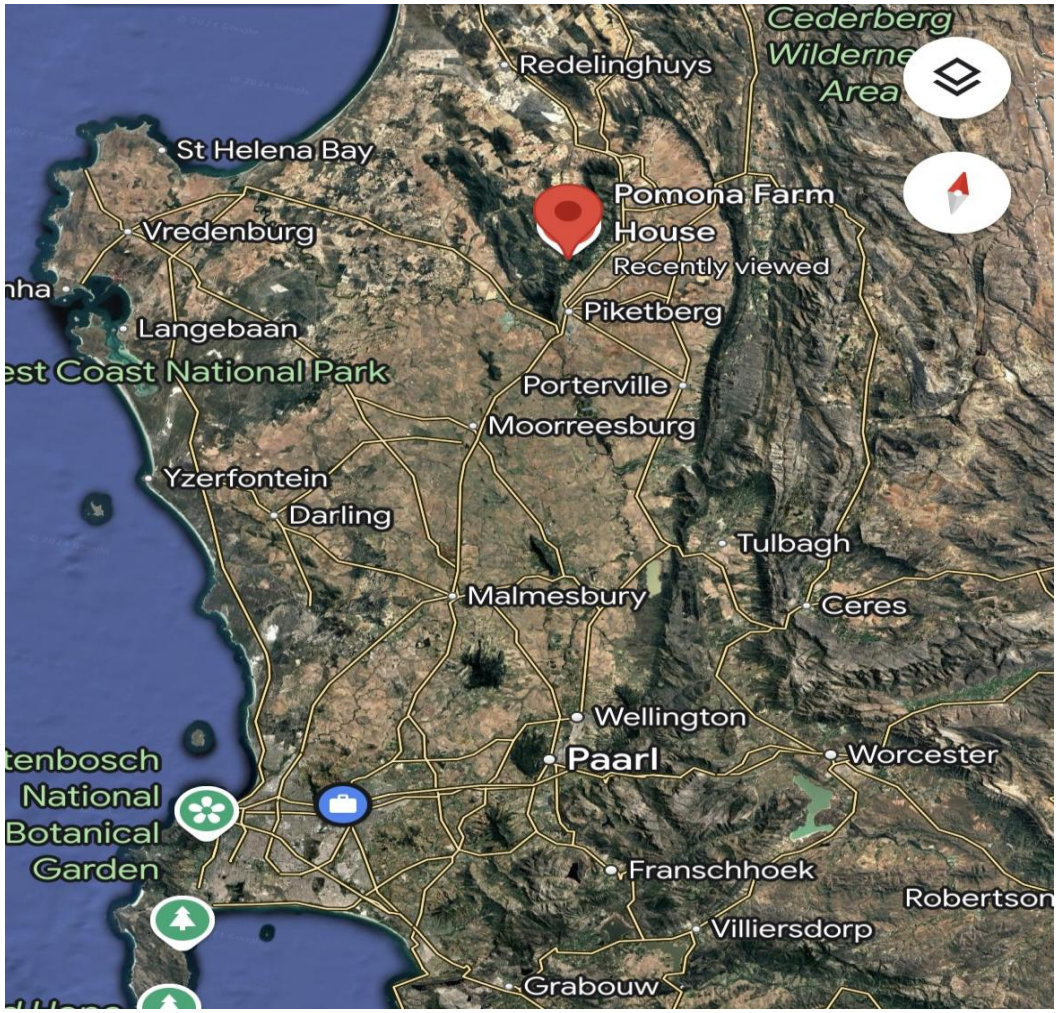
2

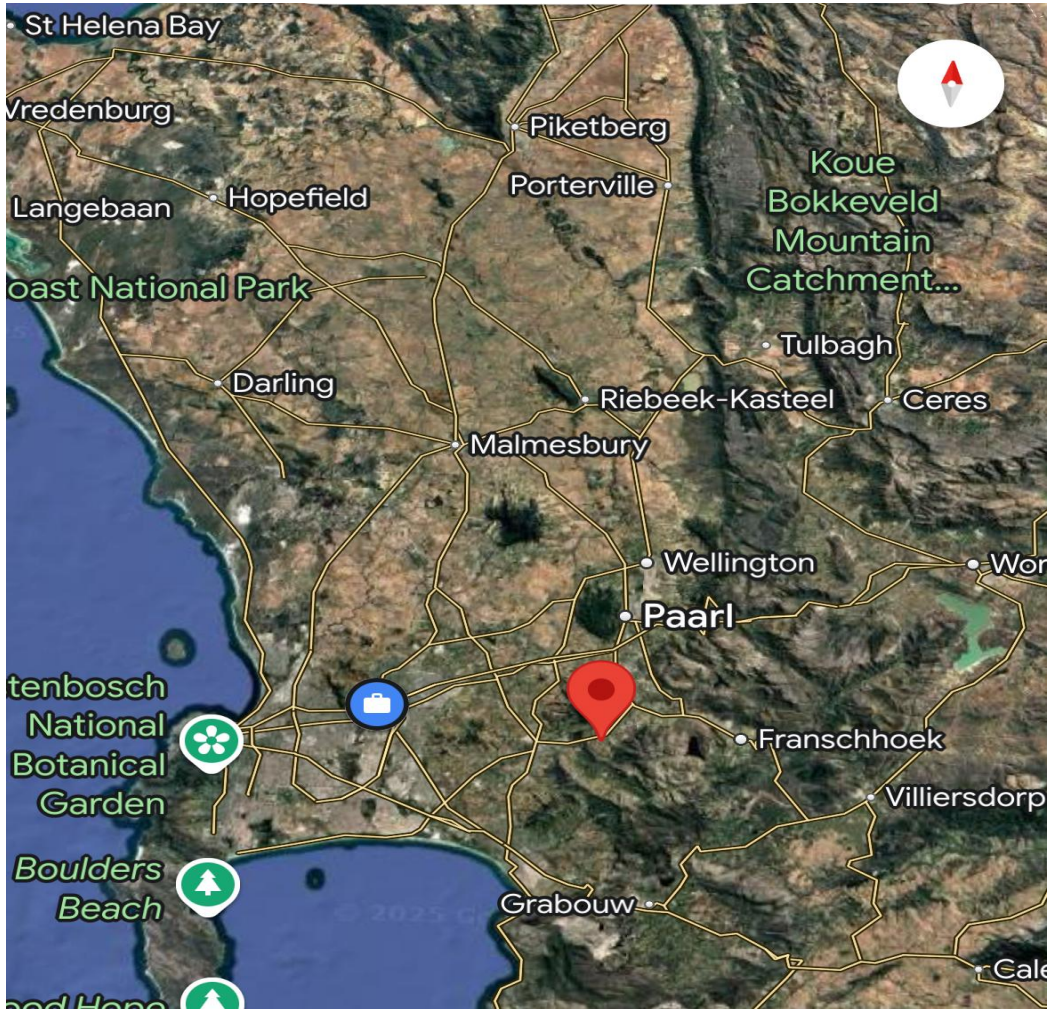
Determine if PGRs can shift flowering outside of the natural peak.

3

Assess the impact of PGRs on flower phenology

# Materials and Methods



# Materials and Methods

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2025 Treatments

| Treatment | Description |
|---|---|
| 1 | Control |
| 2 | 1000ppm Maxcel 2nd and 3d flush |
| 3 | Ethephon 2nd flush |
| 4 | Ethephon 3 d flush |
| 5 | Uniconazole 2nd and 3d flush |

2026 Treatments

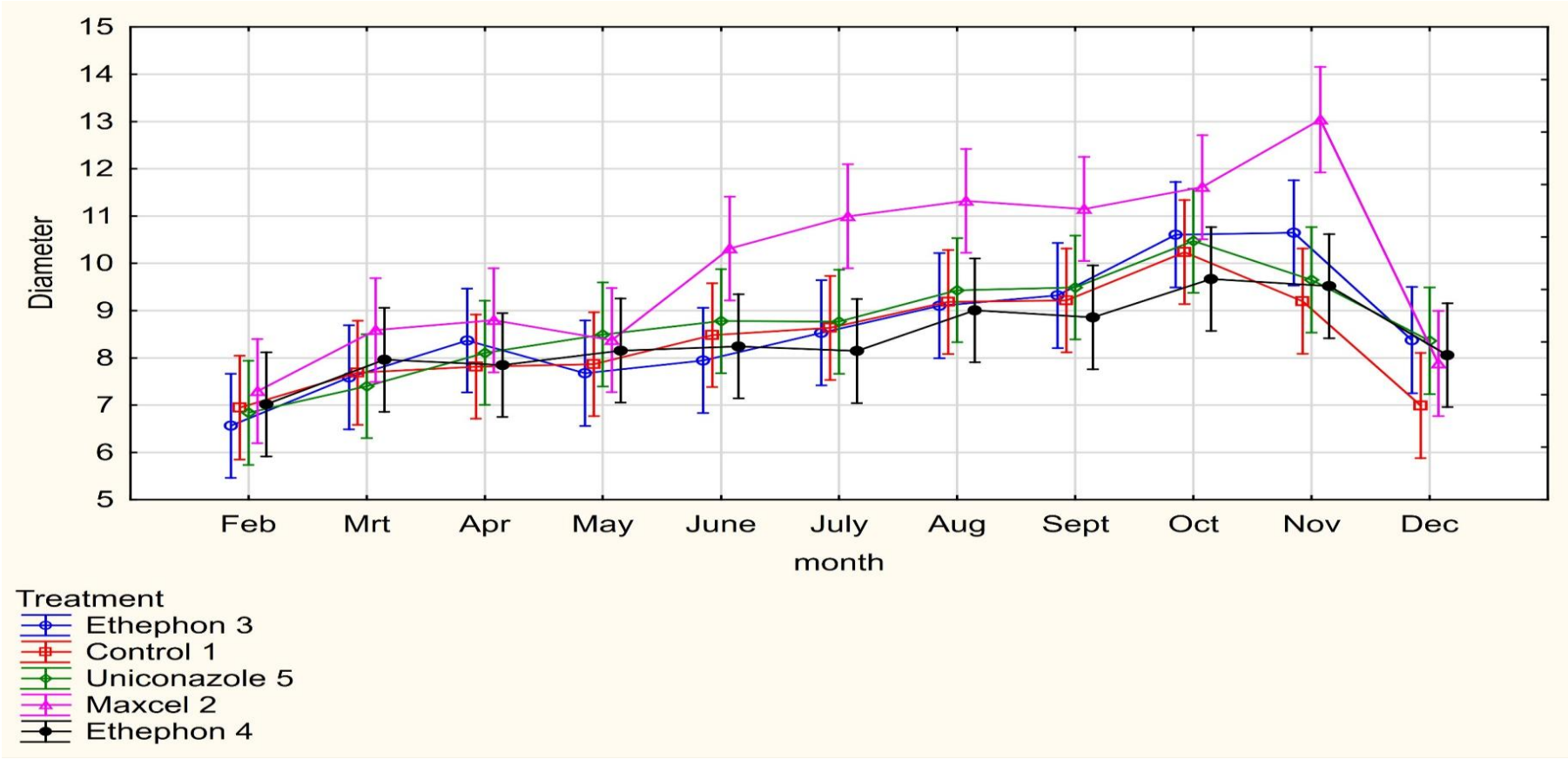
| Treatment | Description |
|---|---|
| 1 | Control |
| 2 | Maxcel 1000ppm |
| 3 | Maxcel 2000ppm |

# Anticipated outcomes

Identify PGRs that:

- Shift flowering window to reduce October flowering peak
- Provide practical PGR recommendations for commercial growers

# Results: Stem Diameter progression



# Results: Flush Progression in Unpruned Systems

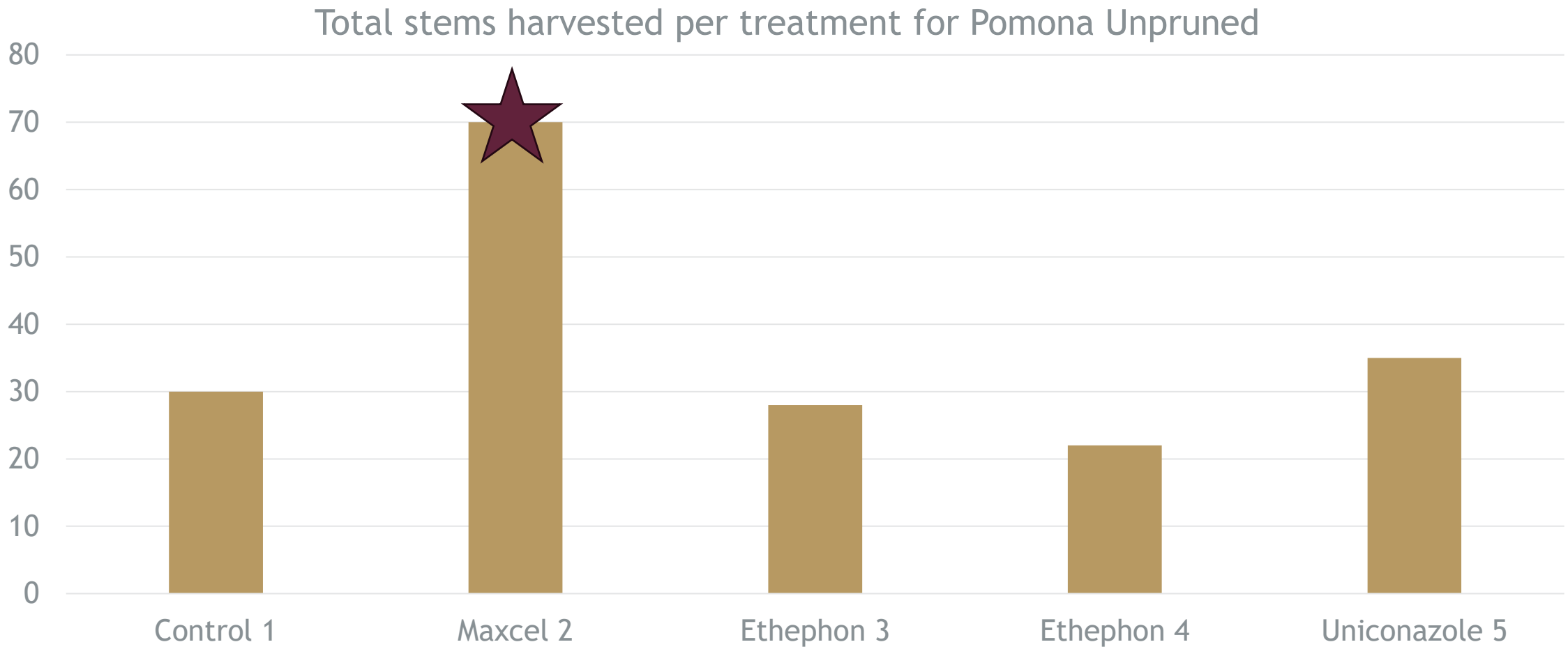
## Pomona

| Control 1 | Feb | Sept |
|---|---|---|
| 1 | 22% | 8% |
| 2 | 38% | 27% |
| 3 | 40% | 28% |
| 4 | 0% | 15% |
| F | 0% | 22% |
| Maxcel 2 | | |
| 1 | 22% | |
| 2 | 32% | 5% |
| 3 | 47% | 27% |
| 4 | 0% | 28% |
| F | 0% | 30% |
| Ethephon 3 | | |
| 1 | 23% | 3% |
| 2 | 23% | 23% |
| 3 | 53% | 37% |
| 4 | 0% | 28% |
| F | 0% | 8% |
| Ethephon 4 | | |
| 1 | 22% | 10% |
| 2 | 30% | 32% |
| 3 | 48% | 30% |
| 4 | 0% | 20% |
| F | 0% | 8% |
| Uniconazole 5 | | |
| 1 | 28% | 13% |
| 2 | 28% | 15% |
| 3 | 43% | 37% |
| 4 | 0% | 20% |
| 5 | 0% | 5% |
| F | 0% | 10% |

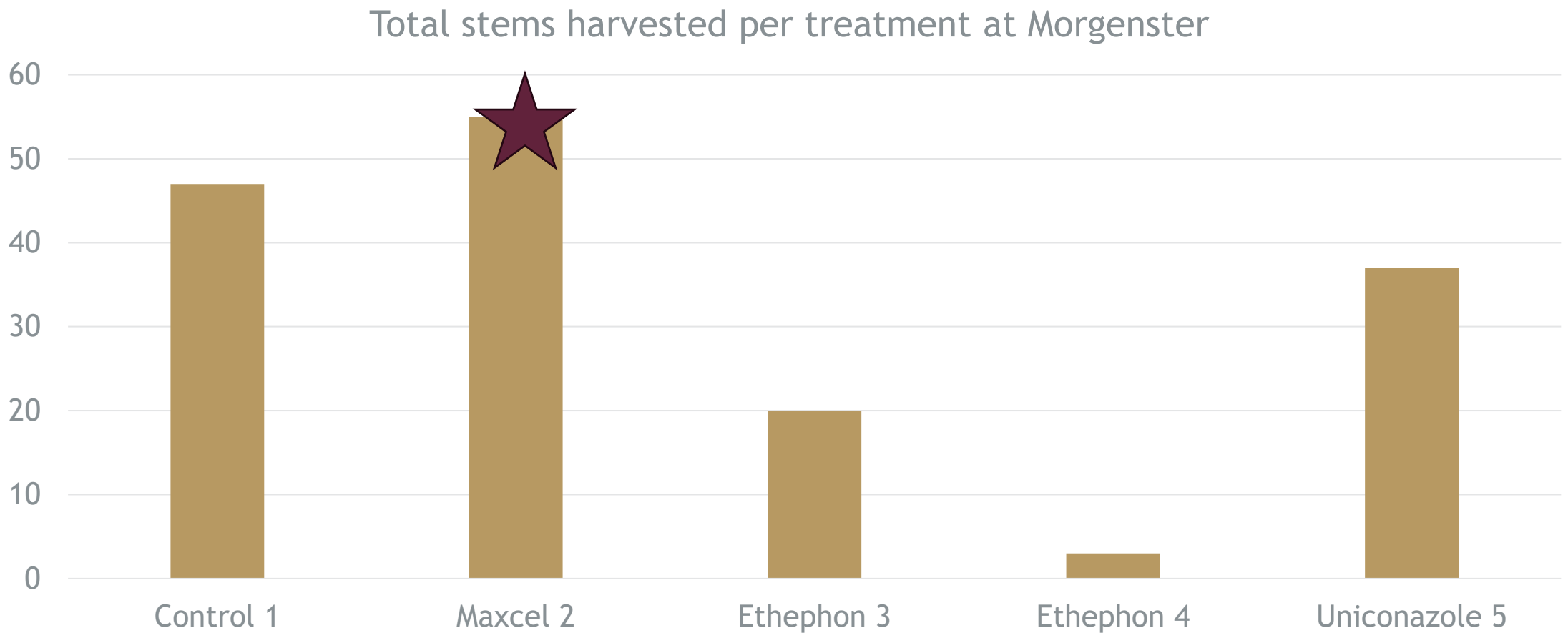
## Morgenster

| Control 1 | Feb | Sept |
|---|---|---|
| 1 | 15,00% | 13,33% |
| 2 | 40,00% | 26,67% |
| 3 | 45,00% | 35,00% |
| 4 | 0,00% | 0,00% |
| 5 | 0,00% | 0,00% |
| F | 0,00% | 25,00% |
| Maxcel 2 | | |
| 1 | 15,00% | 1,67% |
| 2 | 40,00% | 5,00% |
| 3 | 45,00% | 23,33% |
| 4 | 0,00% | 28,33% |
| 5 | 0,00% | 18,33% |
| F | 0,00% | 23,33% |
| Ethephon 3 | | |
| 1 | 15,00% | 11,67% |
| 2 | 35,00% | 35,00% |
| 3 | 50,00% | 33,33% |
| 4 | 0,00% | 10,00% |
| 5 | 0,00% | 0,00% |
| F | 0,00% | 10,00% |
| Ethephon 4 | | |
| 1 | 13,33% | 13,33% |
| 2 | 40,00% | 31,67% |
| 3 | 46,67% | 51,67% |
| 4 | 0,00% | 0,00% |
| 5 | 0,00% | 0,00% |
| F | 0,00% | 3,33% |
| Uniconazole 5 | | |
| 1 | 18,33% | 13,33% |
| 2 | 30,00% | 28,33% |
| 3 | 51,67% | 35,00% |
| 4 | 0,00% | 8,33% |
| 5 | 0,00% | 0,00% |
| F | 0,00% | 15,00% |

# Results: Total Stems Harvested per Treatment



# Results: Total Stems Harvested per Treatment



# Conclusion

- Plant growth regulators effects *P. cynaroides*
- Important what PGR are used
- Potential to influence flowering time

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# Thank you
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