

Nutrient Deficiencies Resembling Disease: Inducing and Differentiating Leafroll-Like Symptoms

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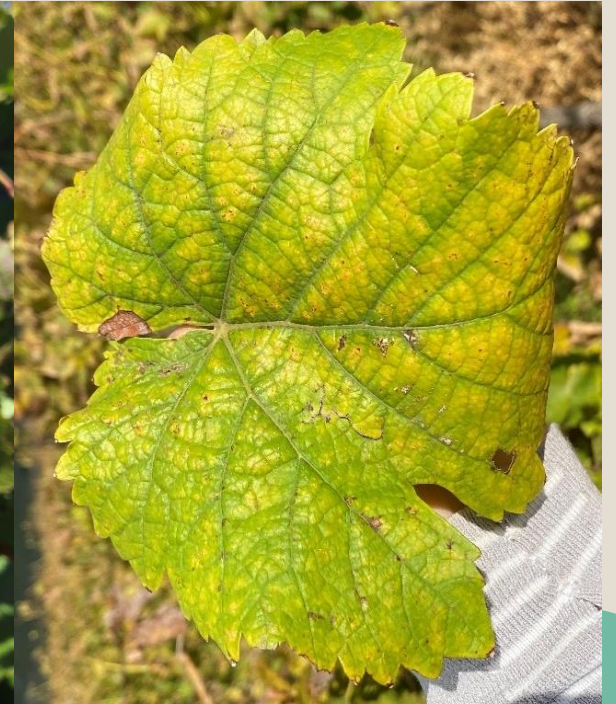
INTRODUCTION

- Grapevine leafroll disease is one of the predominant viral diseases in SA vineyards.
- Common vectors of GLRaVs in SA are mealybugs.
- Variability in symptoms:
 - season to season
 - grape cultivar
 - climatic conditions
- Leafroll symptoms can be confused with
 - Nutrient deficiencies
 - Other diseases
 - Mechanical damage

Red cultivars



White cultivars



GLD could be identified with **artificial intelligence (AI) models** which uses **artificial neural network (ANN)** and visual learning to differentiate diseased leaves from healthy

Aim of project

Build a database of validated grapevine leaf images of symptoms that can be confused with leafroll such as nutrient deficiencies and other

Objectives

- 1) **Capture images** of leaves of field vines showing symptoms of nutrient deficiencies and other diseases
- 2) **Artificially induce** potassium and phosphate deficiencies in pot grown vines



MATERIALS AND METHODS

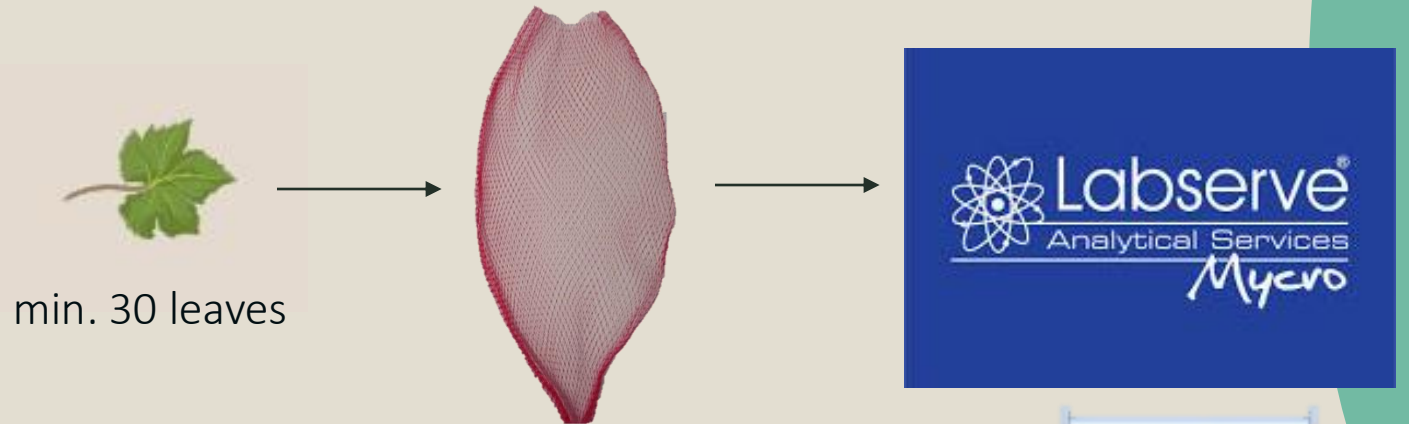
1) CAPTURE IMAGES OF VINES WITH NUTRITIONAL DISORDERS AND OTHER DISEASES

2024 season in areas: Stellenbosch, Paarl and Franschhoek

Focal cultivars

Red: Cabernet Franc
Cabernet Sauvignon
Merlot
Pinotage
Pinot noir
Ruby Cabernet
Shiraz

White: Chardonnay
Chenin blanc
Semillon



MATERIALS AND METHODS

2) INDUCTION OF NUTRIENT DEFICIENCIES ARTIFICIALLY IN POT GROWN VINES

Focal cultivars

Red: Cabernet Franc
Cabernet Sauvignon
Merlot
Pinotage
Pinot noir
Shiraz

White: Chardonnay
Chenin blanc
Semillon

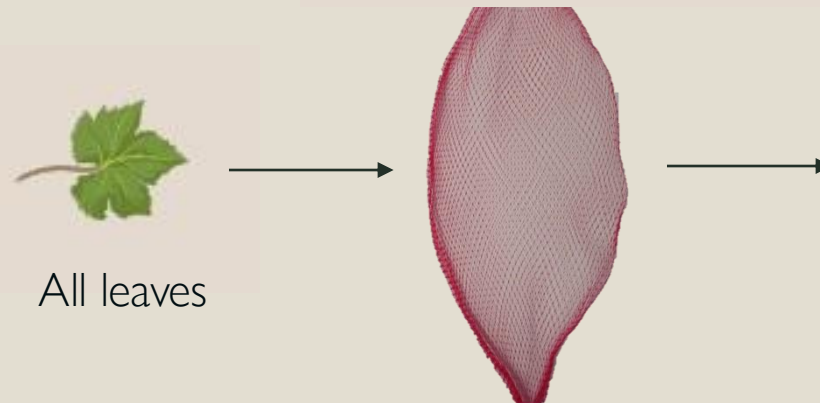
standard
HydroGrow



Without K
HydroGrow



Without P
HydroGrow



RESULTS

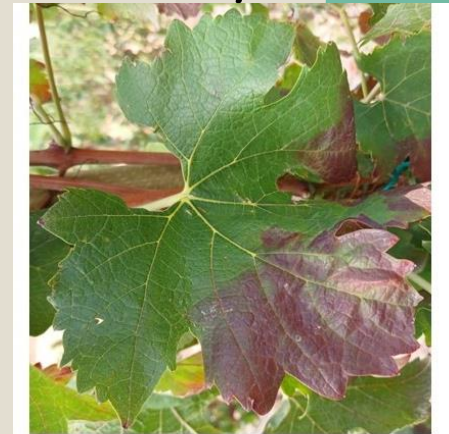
1) CAPTURE IMAGES OF VINES WITH NUTRITIONAL DISORDERS

Red cultivar images: **1686**

White cultivar images: **271**

Magnesium deficiency: 28 Vineyards

Phosphorous deficiency:
2 vineyards



Cabernet Sauvignon

Shiraz

Pinot noir

Semillon

Shiraz

RESULTS

1) CAPTURE IMAGES OF VINES WITH OTHER DISEASES

Red cultivar images: 63

White cultivar images: 607

Esca leaf symptoms



Cabernet Franc

Cabernet Sauvignon

Aster Yellows symptoms



Colombar

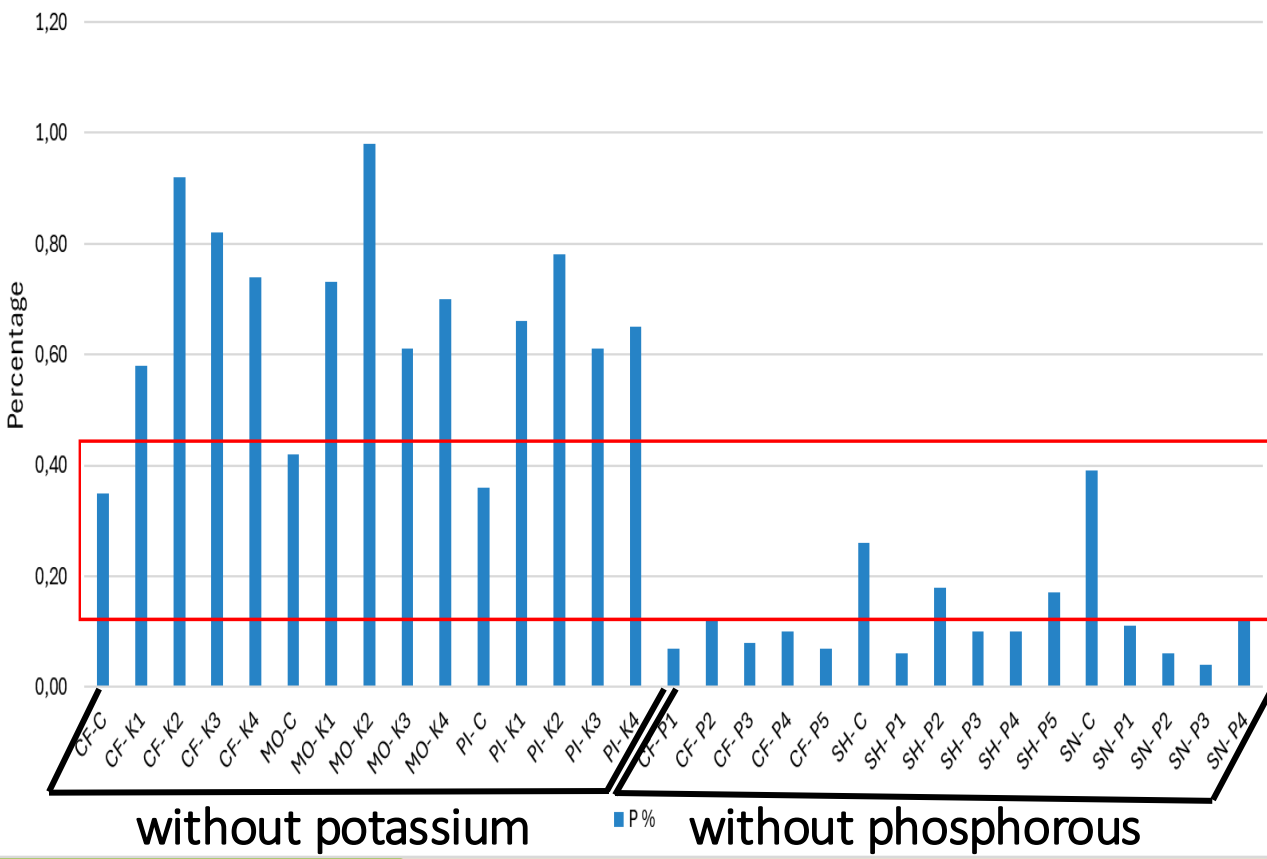
Chenin Blanc



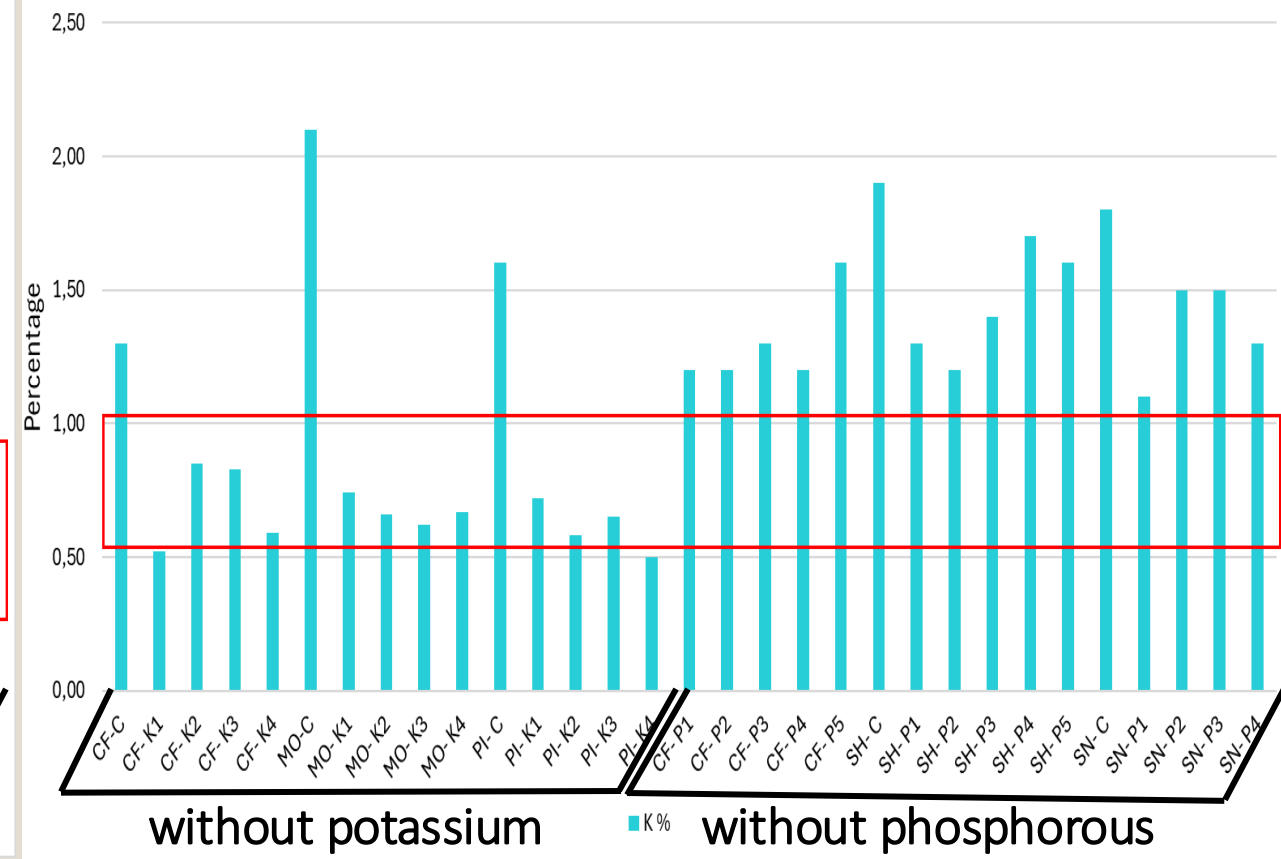
RESULTS

2) INDUCTION OF NUTRIENT DEFICIENCIES ARTIFICIALLY IN POT GROWN VINES

Phosphorous levels



Potassium levels

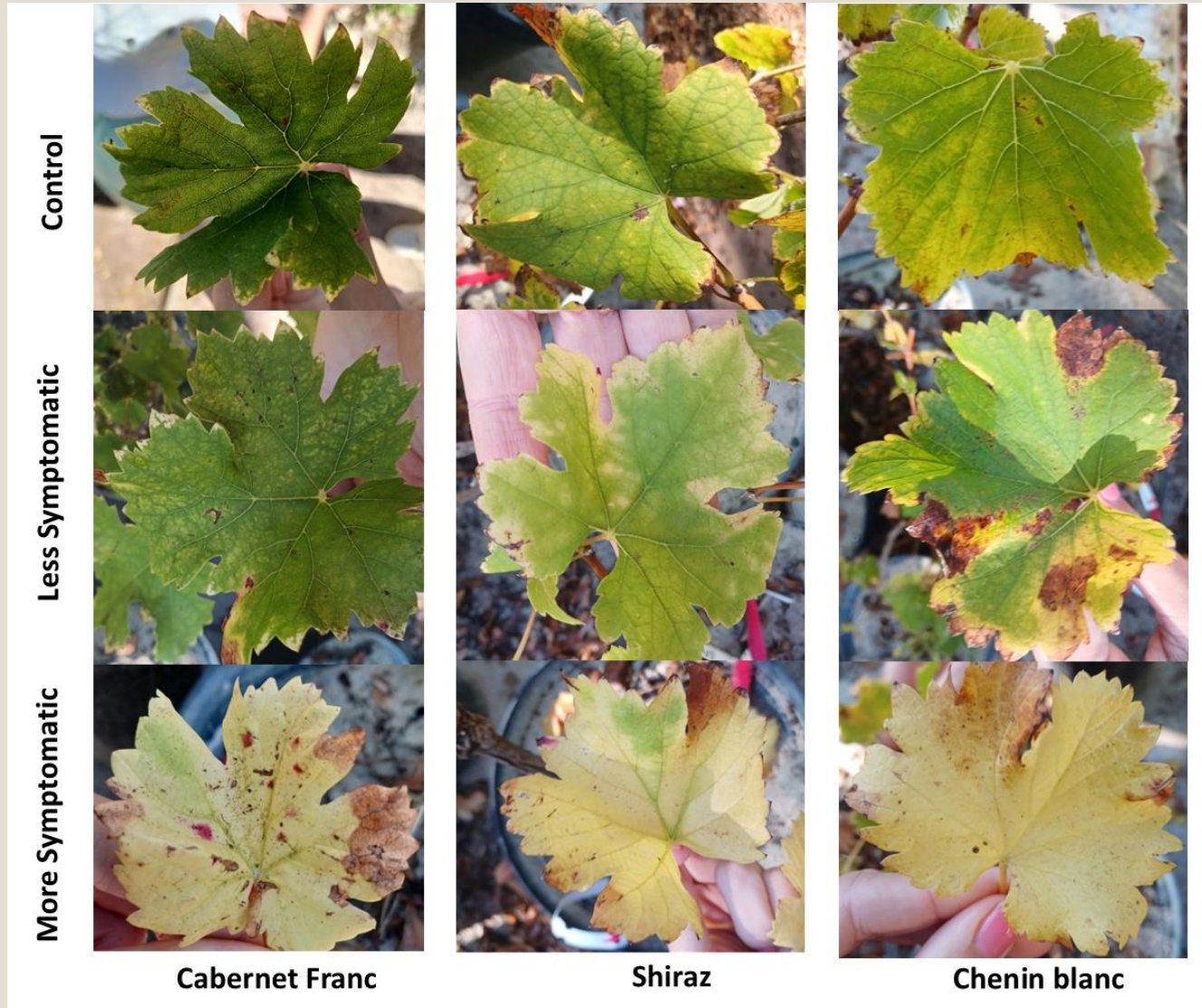


Symptoms were only observed for: Cabernet Franc, Chenin blanc, Merlot and Pinotage and Shiraz

RESULTS

2) INDUCTION OF NUTRIENT DEFICIENCIES ARTIFICIALLY IN POT GROWN VINES

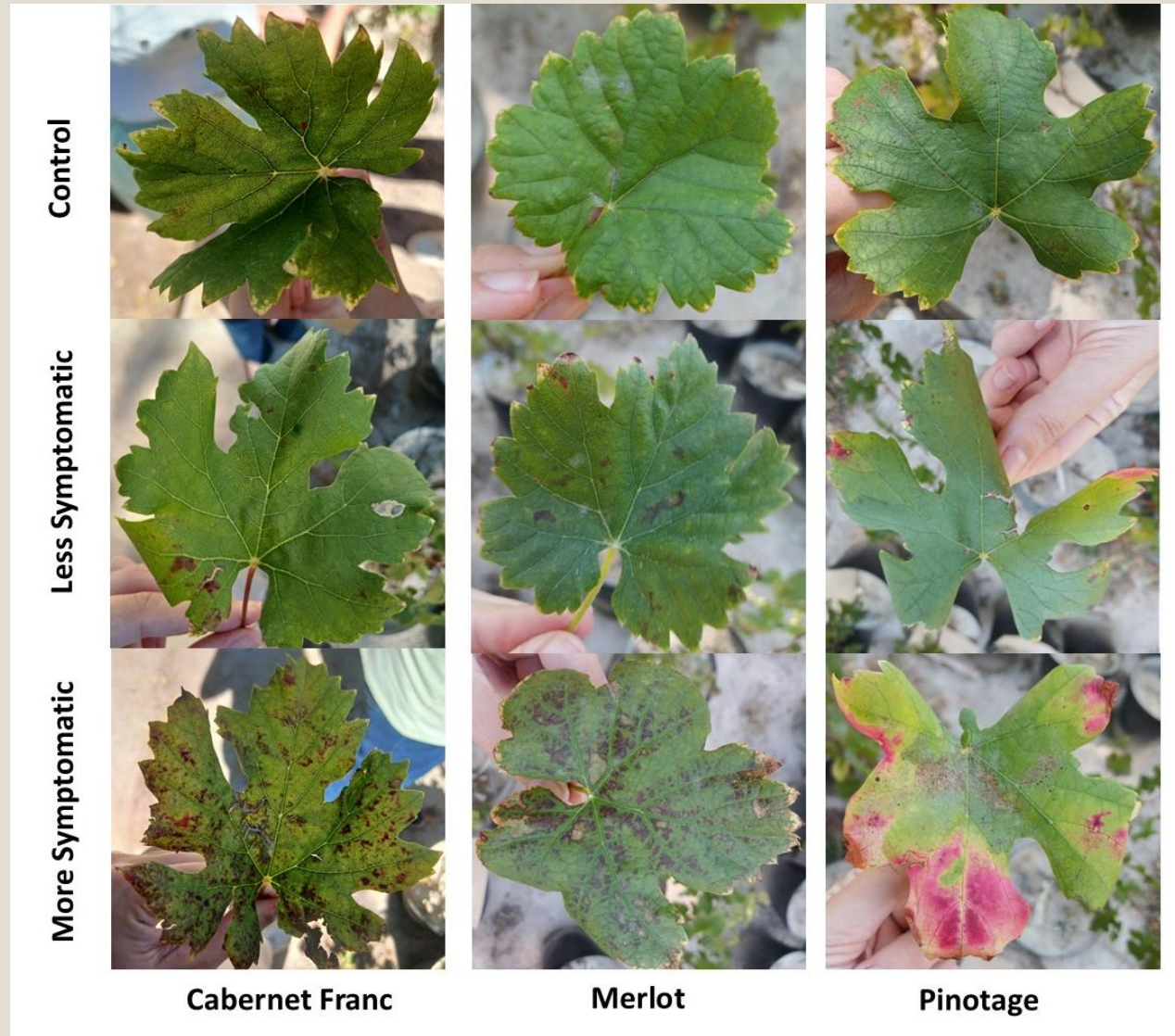
Different phosphorous deficiency symptoms



RESULTS

2) INDUCTION OF NUTRIENT DEFICIENCIES ARTIFICIALLY IN POT GROWN VINES

Different potassium
deficiency symptoms



CONCLUSION

- Magnesium deficiency was the most prominent in field vines
- Database of images of nutrient deficiencies, Aster Yellows and Esca could be generated
 - confirmed by ELISA to be GLRaV-3 free
 - nutrient deficiencies confirmed
- These validated images were be used in a SA Wine funded project to develop a CNN based model to identify leafroll infected vines
- The further development of a smartphone-based application will enable non-experts to identify leafroll infected vines and will form part of a larger management strategy for the control leafroll



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