Climate change impact on viroid diseases. Application to CBCVd - infected hops

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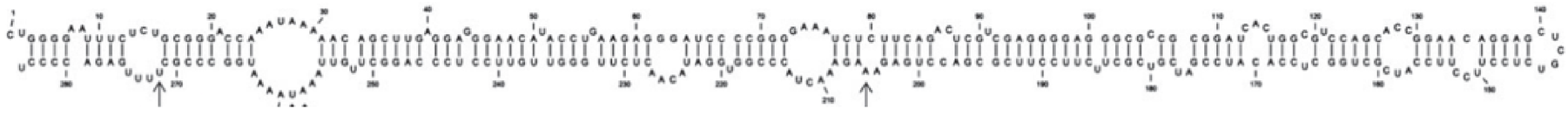

Fig. 1: Structure of *Cocadviroid rimocitri* (Citrus bark cracking viroid, CBCVd)

INTRODUCTION

Cocadviroid rimocitri (Citrus bark cracking viroid, CBCVd, Fig. 1) poses a major threat to Slovenian hops. First observed in Slovenia in 2007, latter confirmed using next-generation sequencing, it has since spread extremely rapidly through hop fields in the region.

As a sap-transmitted pathogen, mechanical handling and the production of infected plant material are the main modes of transmission of the viroid to other plants.

However, fluctuations in the infectivity, incidence, and severity of the disease have been observed during variations in temperature and precipitation, highlighting a possible impact of climate on the reproductive cycle and expression of CBCVd.

METHODS

To study the effect of climate change on CBCVd-infected hops, two main environmental stress factors will be modeled:

- **Temperature** (temperature increase and early/late frosts)
- **Precipitation** (drought and heavy rainfall)

The response of viroid pathogenicity to climate change in hop fields will be analyzed through four main components:

- Visual assessment of hop **phenotype** (Fig. 2) and **physiological analysis** of hop
- Analysis of **infection patterns in** hop fields over several decades (Fig. 3)
- Quantification of CBCVd **concentration in different organs** of the hop plant (Fig. 4-5)
- Extraction and analysis of selected **plant secondary metabolites (Fig. 6)**

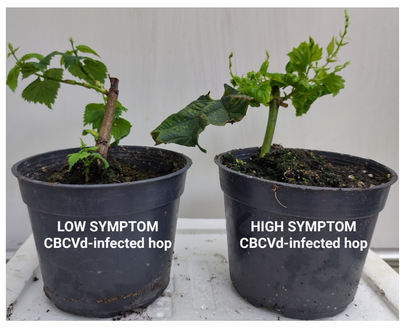

Fig. 2: Visual assessment of the phenotype of CBCVd-infected hops in growth chambers.

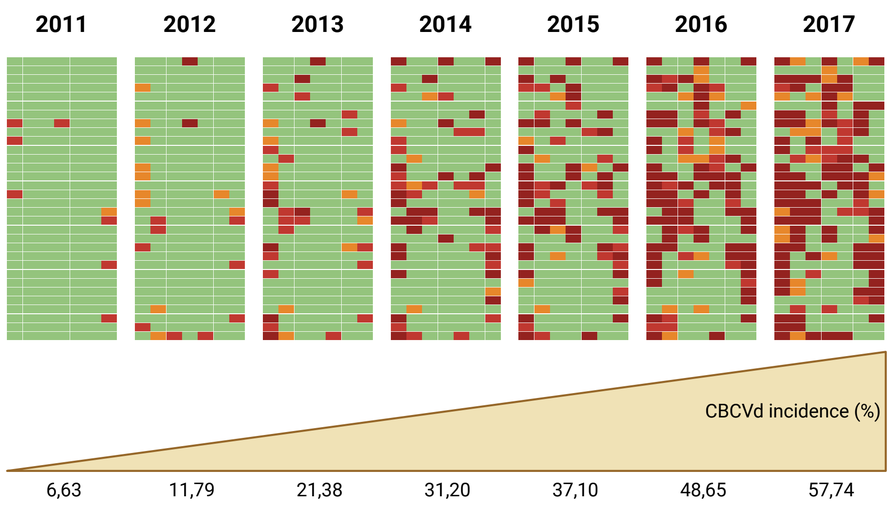

Fig. 3: Modeling of infection patterns in hop fields based on temperature and precipitation variations in conventional hop fields.

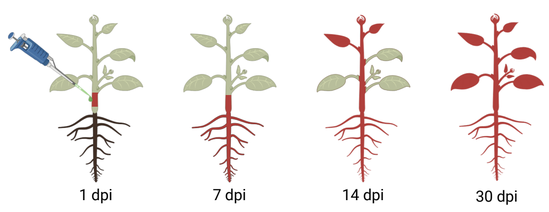

Fig. 4: Spatio-temporal distribution of the viroid in infected hops in response to climate change.

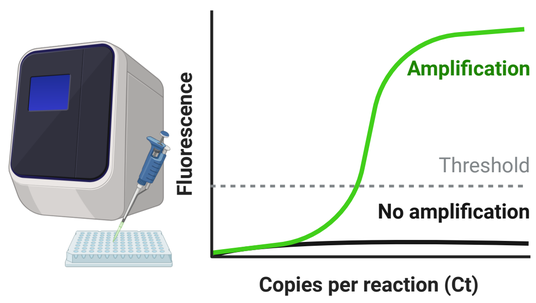

Fig. 5: Real-time quantification of viroid in response to climate change using RT-qPCR.

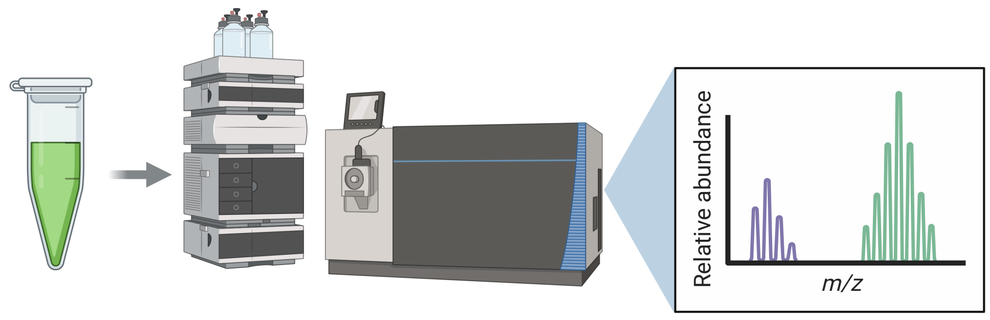

Fig. 6: Analysis of secondary metabolites in CBCVd-infected hops in response to climate change using high-performance liquid chromatography (HPLC).

EXPECTED RESULTS

We expect climate change to have a positive effect on the pathogenicity of CBCVd in infected hops (Fig. 7), especially in the infectivity and aggressiveness of the viroid.

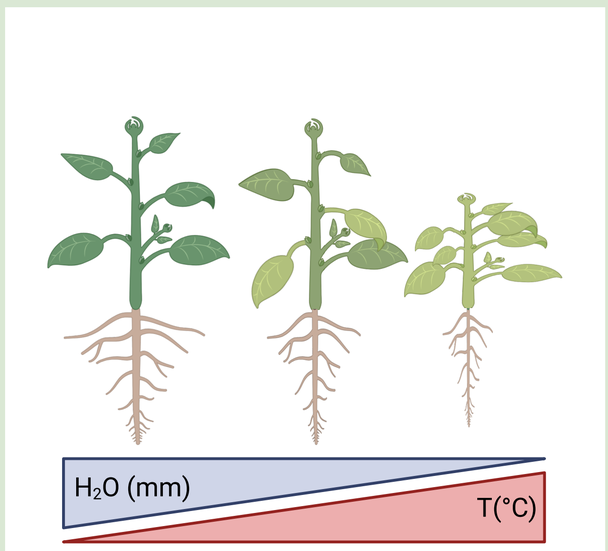

Fig. 7: Pathogenicity of CBCVd in hops in response to climate change.

To better understand the influence of environmental stress conditions, CBCVd-infected hops will be observed and studied in several contexts:

- plants placed in controlled **growth chambers**
  - in vitro
  - in vivo in pot experiments
- **field** observations in **conventional** hop fields

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