



**WORLD POTATO
CONGRESS**

Speaker Disclosure

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Implementation of an early warning system for sustainable preventive management of potato Late blight (*Phytophthora infestans* de Bary), as an adaptation measure against the variability of climate change in Latin America



Ivette Acuña¹, Florencia Lucca², Cristina Tello³, Rodrigo Morales⁴, Arnulfo Gutiérrez⁴, Rodrigo Bravo¹, Constanza Sepúlveda¹

¹INIA Chile, ²INTA Argentina, ³IDIAP Ecuador, ⁴INIAP Panama

Late Blight (*Phytophthora infestans*)



- ✓ Potato is a major crop in Latin America and is the main food in family farming.
- ✓ Potato late blight, caused by the oomycete *Phytophthora infestans*, is a disease capable of causing 100% loss of production when environmental conditions are favourable.
- ✓ Today, Late blight is considered a re-emerging disease due to pathogen variability and climate instability that favours its presence and dispersion, with a high incidence and severity.

Objective

To constitute a platform of specialists in potato late blight with the aim to develop and implement an early warning system as tool to support productive systems of family farming in participating countries, according to available technology, enabling reductions in losses caused by this disease.



Two systems were implemented

- One based on real-time connected weather station network information.

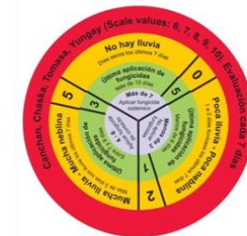
- The other, a manual system that uses local environmental condition observations.



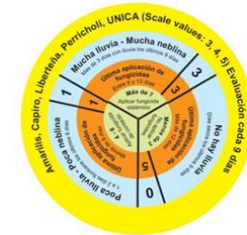
Chile:
<http://tizon.inia.cl>

Argentina:
Phytoalert® INTA.

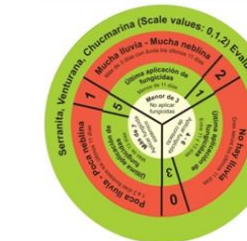
Ecuador and
Panama (CIP):
DSS-HH



Susceptible
(Score 6 a 9)



Moderad.
resistant
(Score 3 a 5)



Resistant
(Score 0 a 2)

Phytophthora infestans monitoring

EC_1 EU_2_A1 Other

➤ Isolate collection using FTA cards



528 isolates

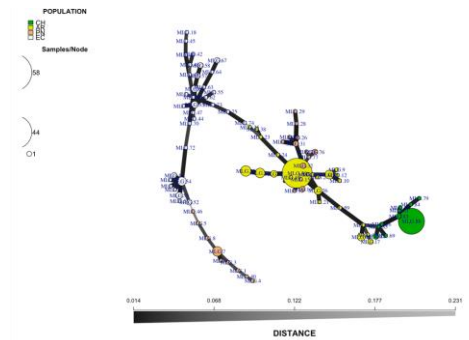
Argentina, Chile, Ecuador, Panamá

171 isolates

Brasil, Costa Rica, Perú, Uruguay

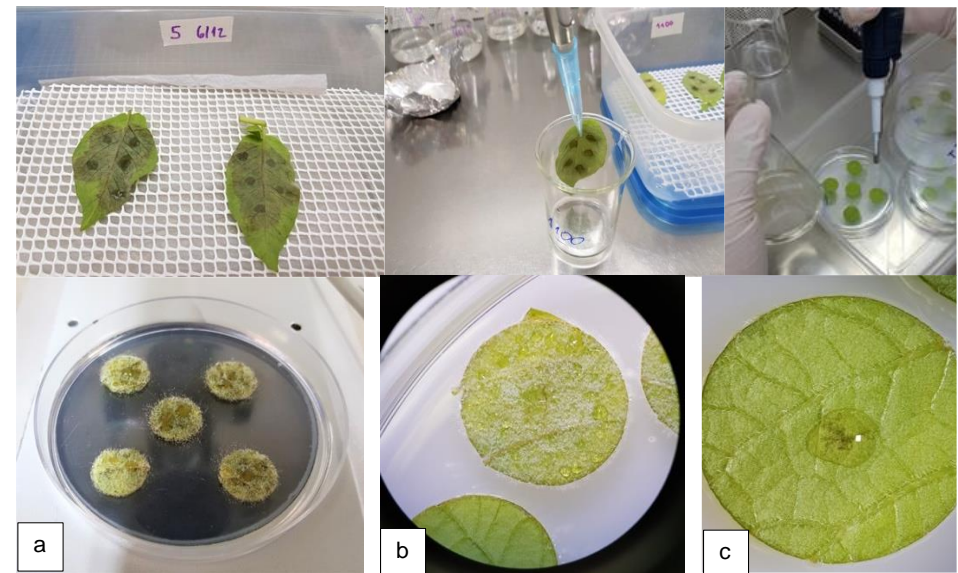


➤ Population genotyping using 12 SSR markers



Varietal susceptibility

- Resistance of the main commercial and native potato varieties was determined using leaf discs in laboratory and field plots.
- The percentage of foliage damaged by late blight during the season and tuber yield were assessed.
- AUDPC and rAUDPC were determined.

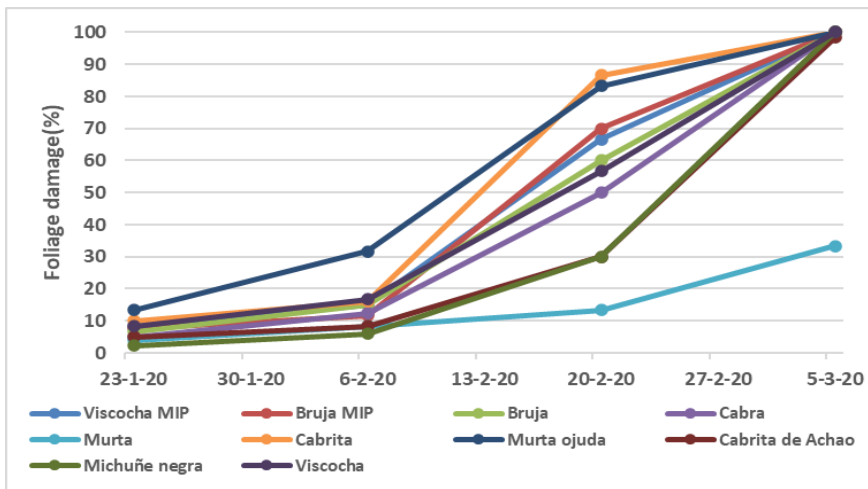


Evaluation of the severity and incidence of sporulation and necrosis of the fungus on potato leaflets inoculated with *P. infestans*.

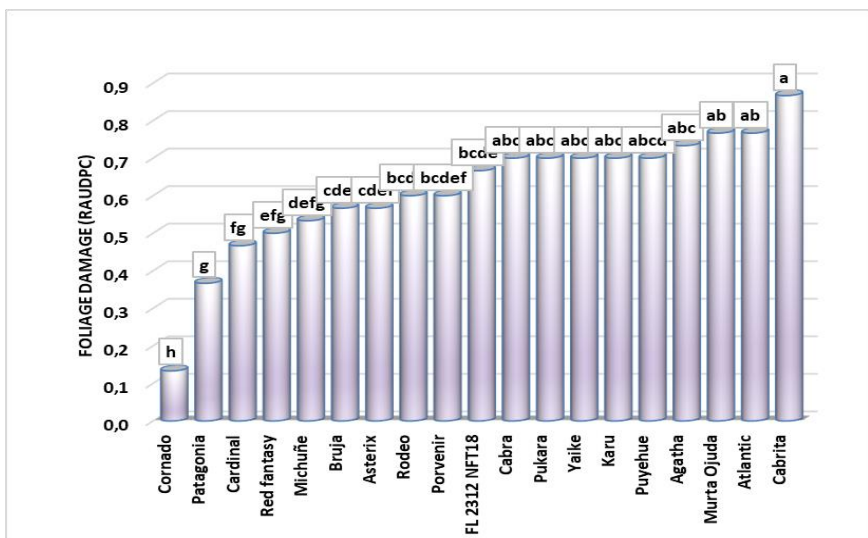


Aerial view of the varietal resistance assessment plots. The difference in foliage damage can be seen in the rows with susceptible plants (no foliage) versus the most resistant to late blight (green foliage).

Varietal susceptibility



Late blight disease curve in potato plants of different native varieties



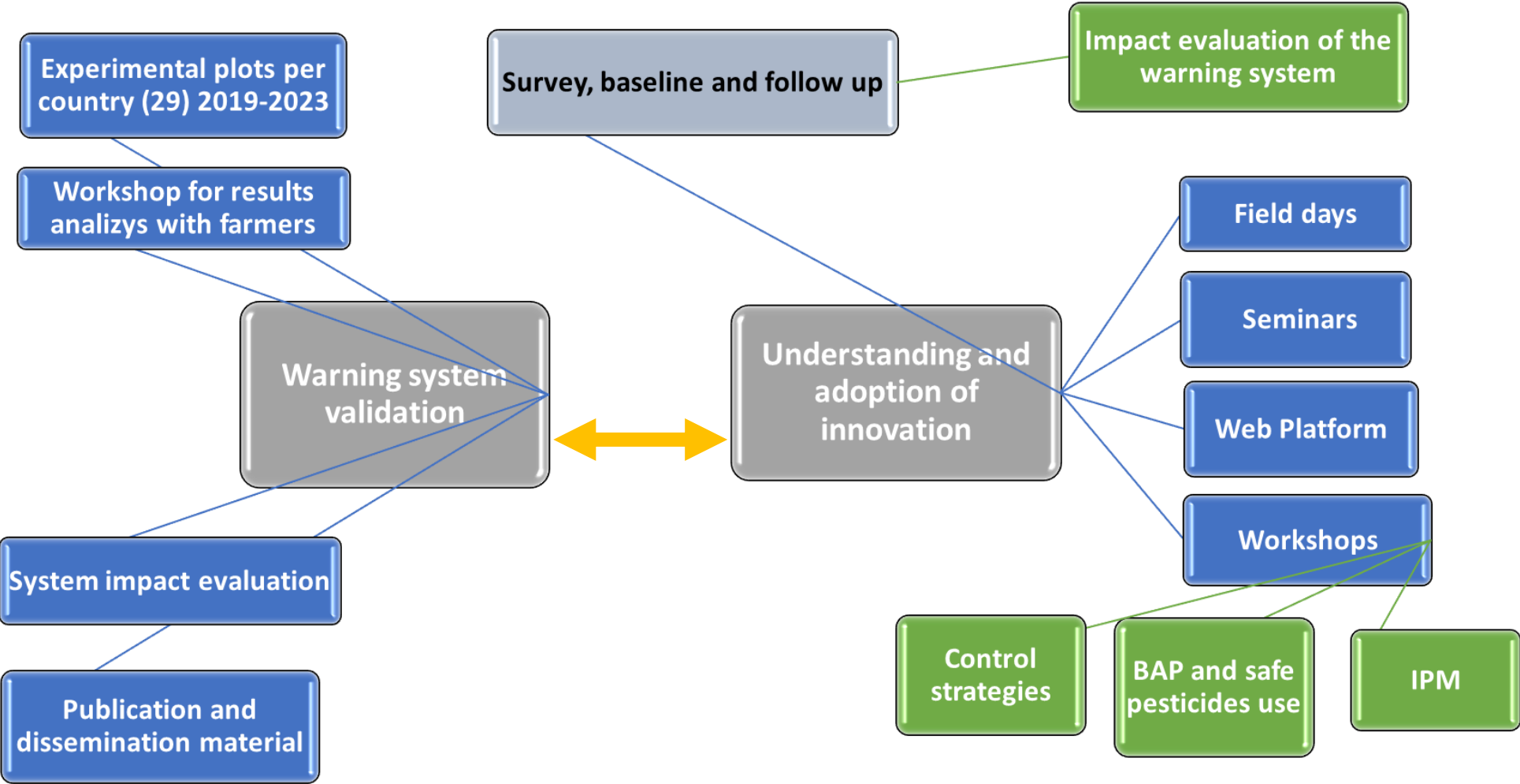
Relative area of foliage damage by late blight in potato plants of different commercial and native varieties

Variety	Susceptibility index
Cornado	1,4
Murta	2,2
Patagonia	3,8
Michuñe	4,5
Cardinal	4,8
Cabrita de Achao	5,1
Red fantasy	5,2
Asterix	5,9
Rodeo	6,2
Porvenir	6,2
Bruja	6,6
Cabra	6,9
FL 2312 NFT18	6,9
Yaiké	7,3
Pukara	7,3
Karu	7,3
Puyehue	7,3
Viscocha	7,3
Agatha	7,6
Viscocha MIP	7,6
Bruja MIP	7,6
Atlantic	8,0
Murta Ojuda	8,8
Cabrita	9,0

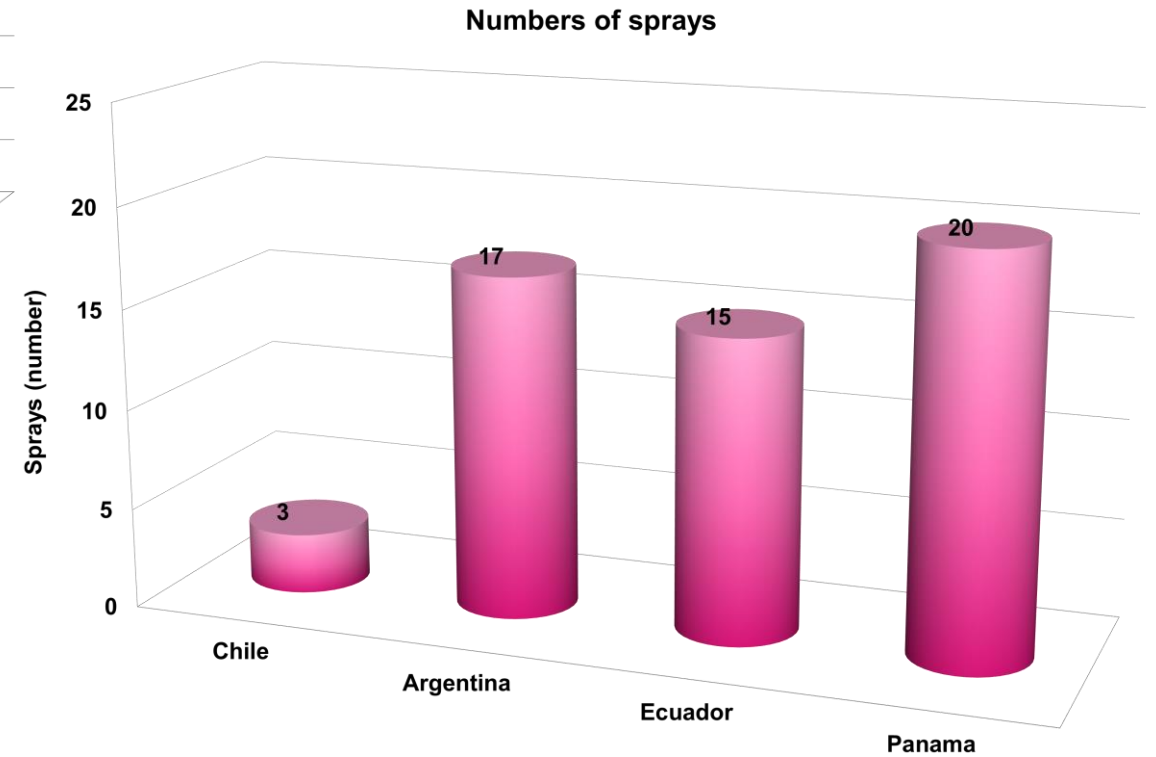
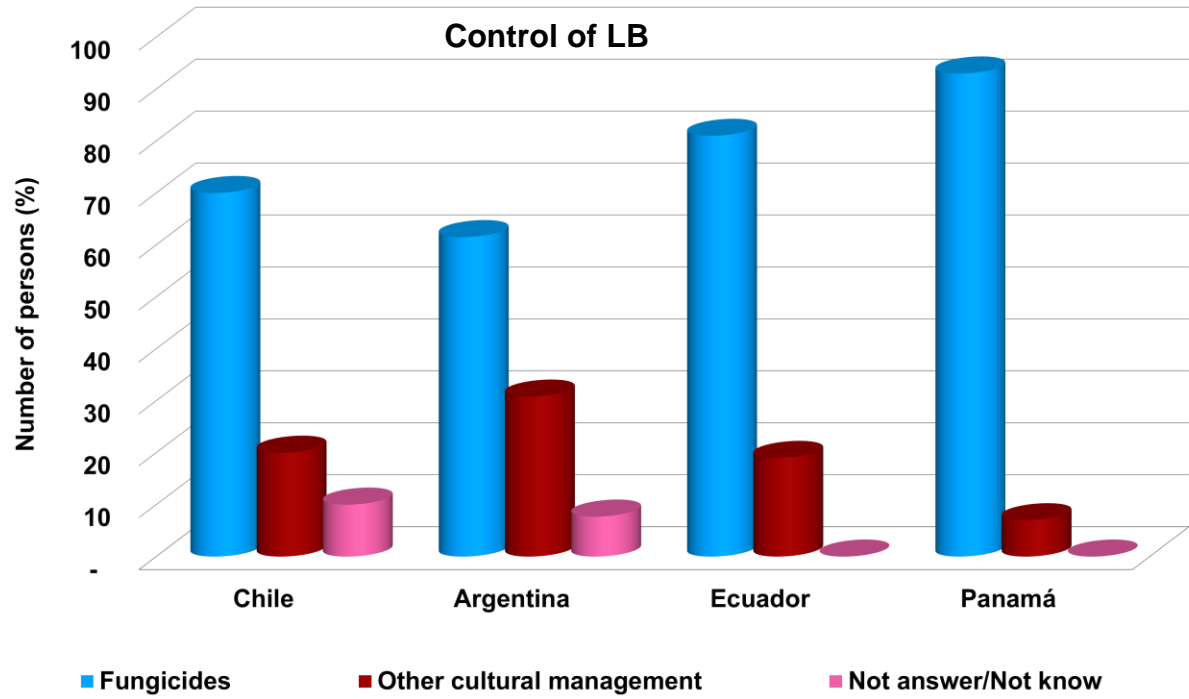


Susceptibility index between 1 and 9, where 1 is very resistant and 9 is very susceptible, according to the scale described by Forbes et al, (2014).

Working model



Farmers baseline

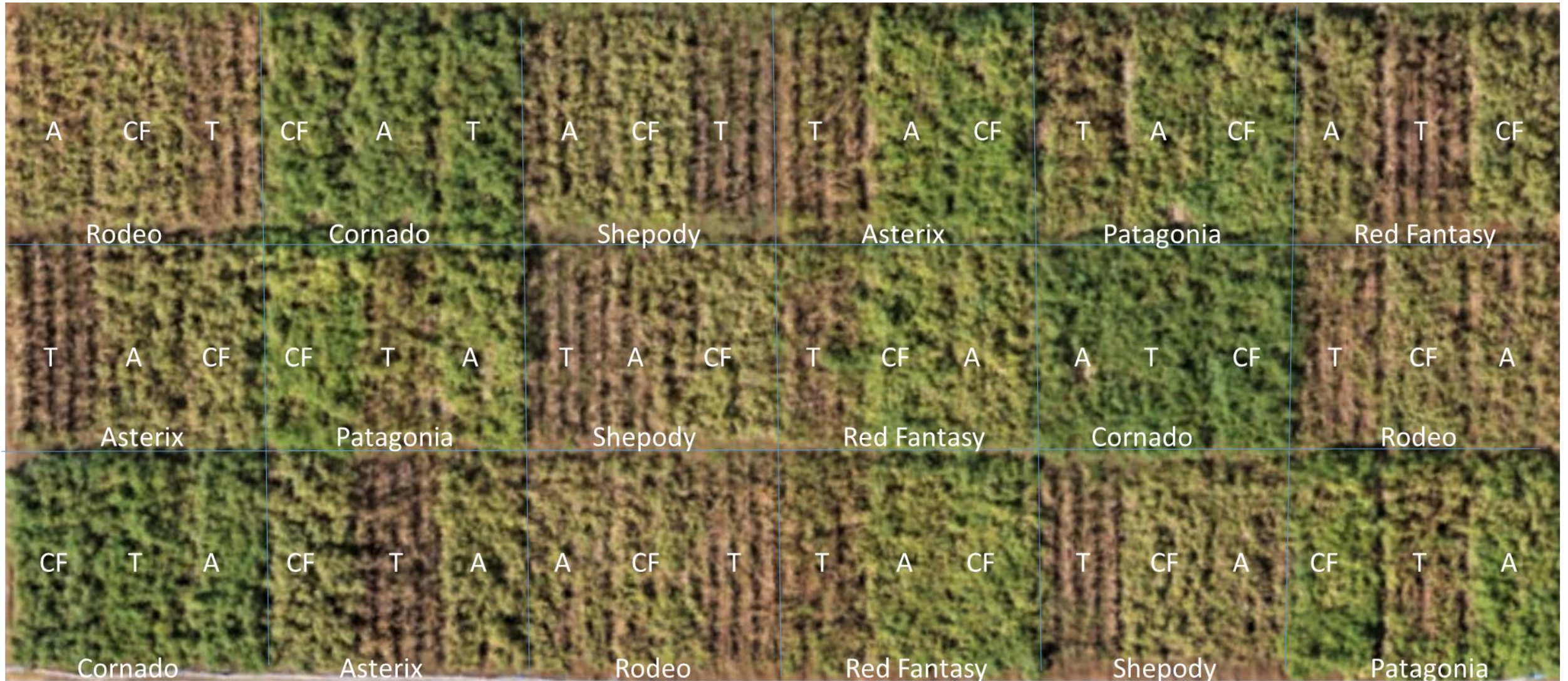


Methodology

- Experimental plots were established under field conditions in the 2018-19 to 2022-23 seasons.
- Split plot design, 4 repetitions:
 - ❖ Main plot: Varieties of different susceptibility
 - ❖ Subplot: Treatments: T1. Untreat control, T2. Fungicide application on a calendar schedule, T3. Fungicide application according to alert system
- The percentage of damaged tissue, AUDPC, rAUDPC and the number of applications, the cost of applications and the Impact Index (EIQ) were determined.
- Information from the Cornell University platform was used to calculate EIQ (<https://cals.cornell.edu/new-york-state-integrated-pest-management/risk-assessment/eiq/eiq-calculator>). For the cost calculation, the value of the product on the local market, updated to March 2023 value, was used.



Warning system validation

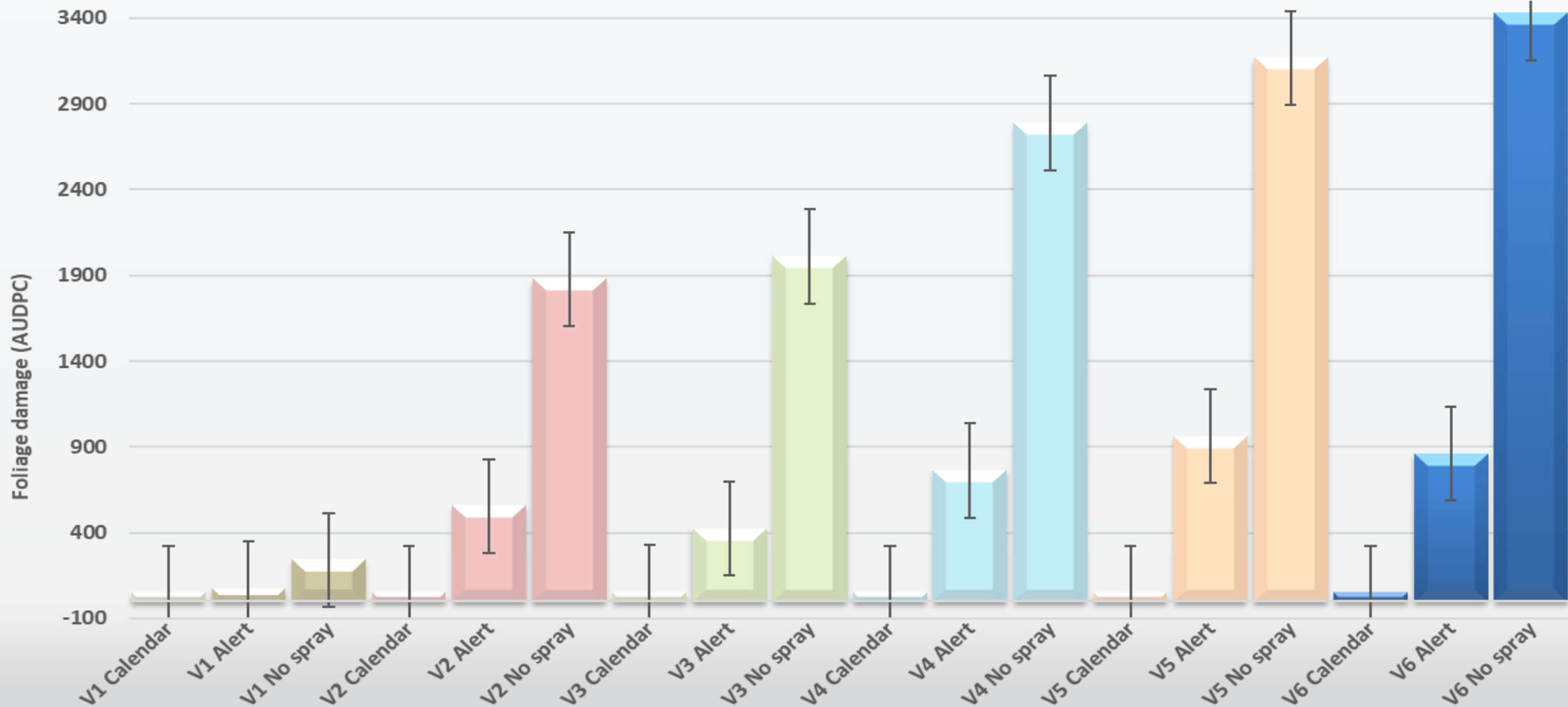


CF: Calendar applications. T: No sprays. A: Application according to alert system

Results

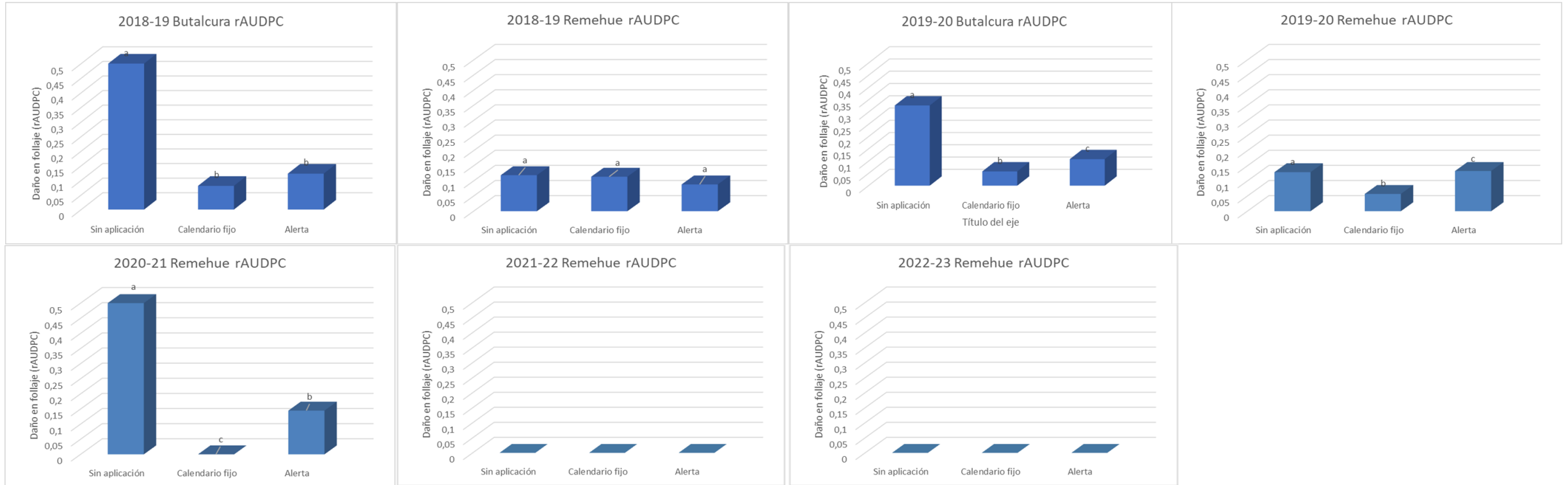


Early warning system validation INIA Remehue 2020-21



Trat: $P < 0.0001$; Var: $P < 0.0001$; var*trat: $P < 0.0001$

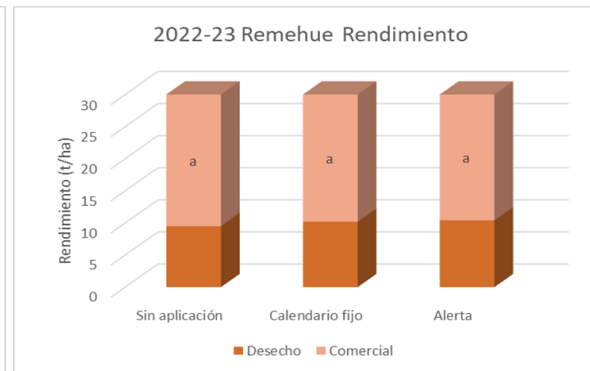
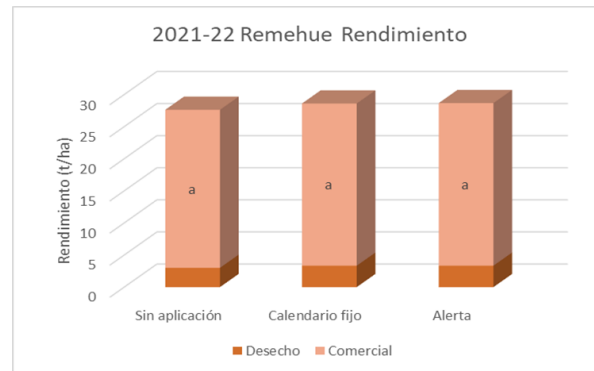
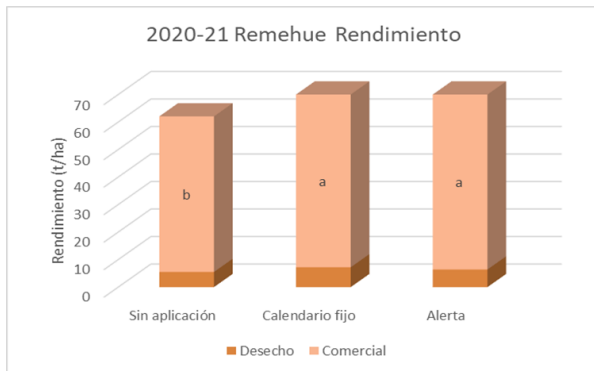
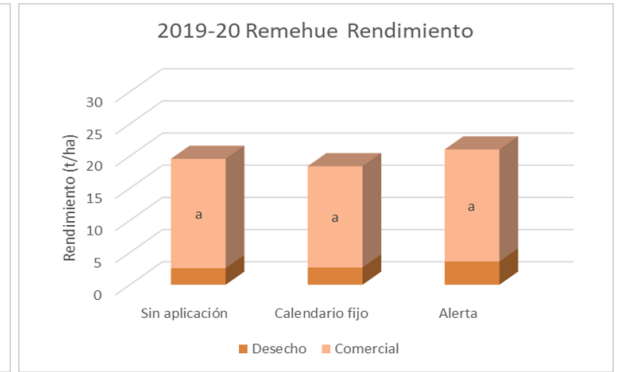
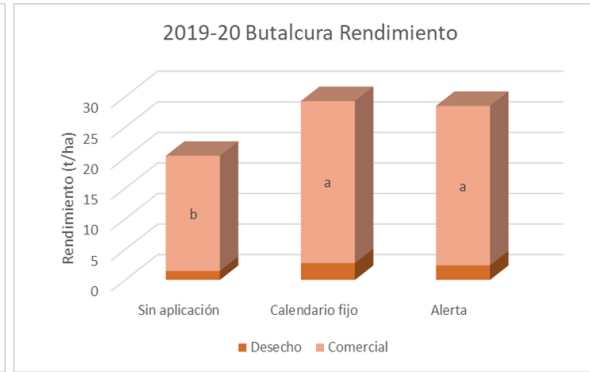
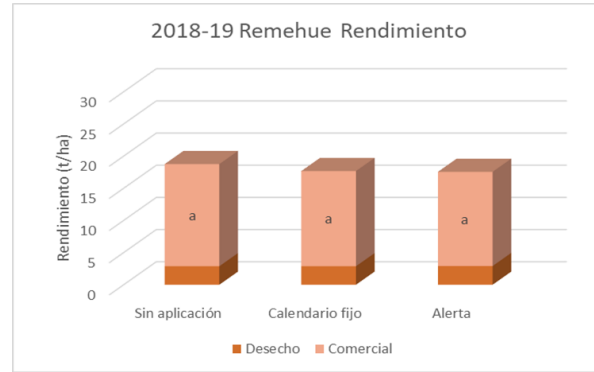
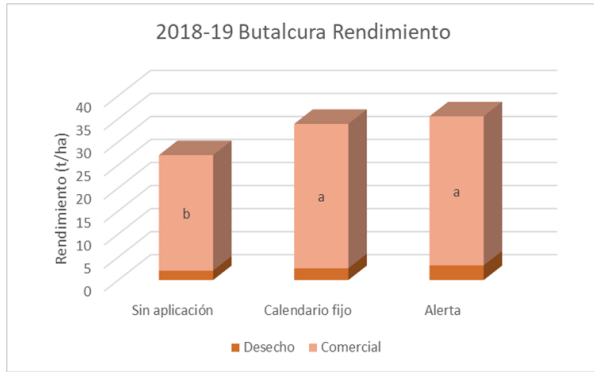
Warning system evaluation: LB damage by Season, application



Foliage damage by late blight treatment factor on potato plants of different cultivars managed under early warning, fixed schedule, and no application strategies during the 2018-19 to 2022-23 seasons.

- ❖ The applications according to the alerts offer a very similar control to the fixed calendar, and both better than without application, when the disease occurs.

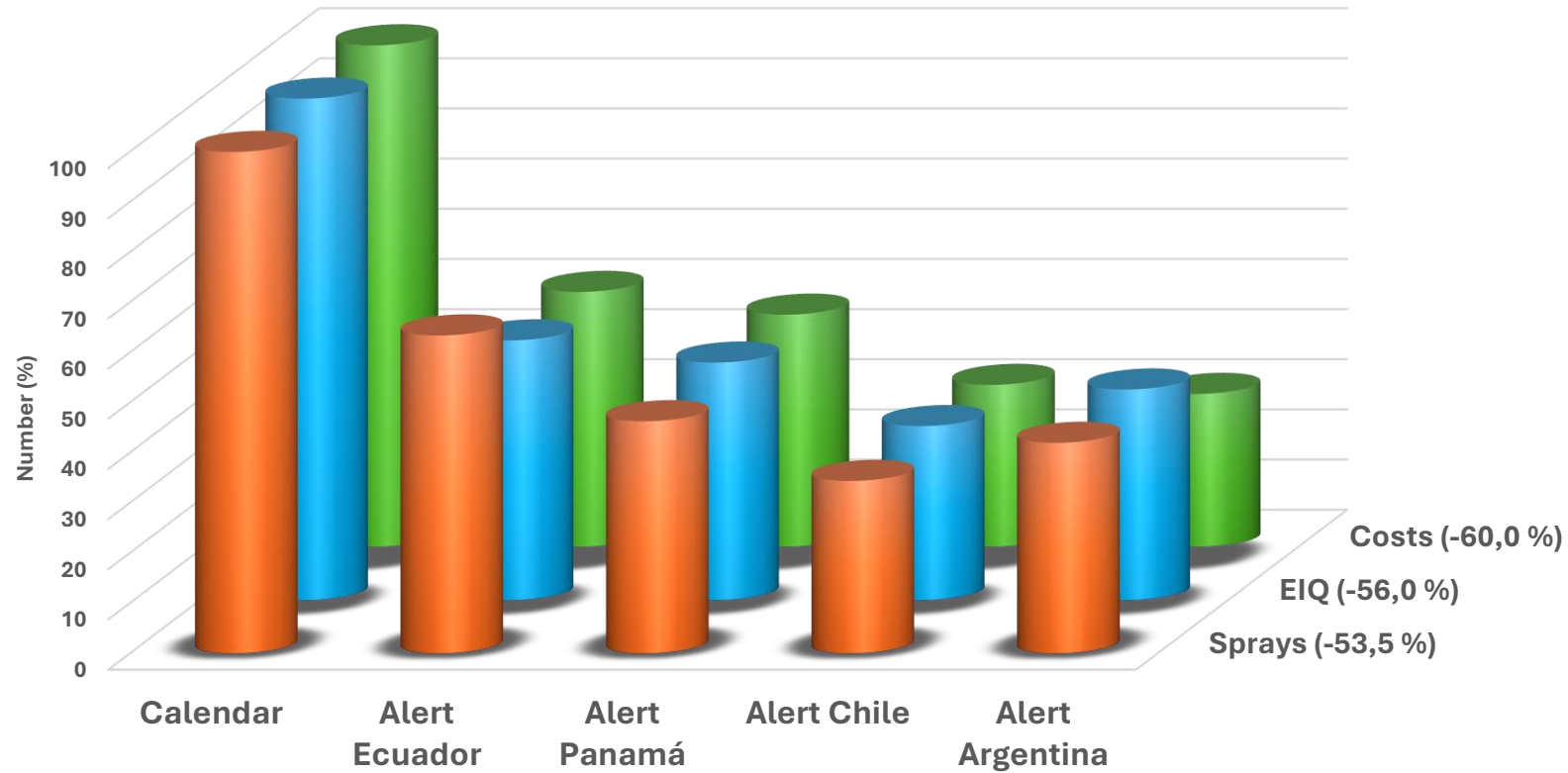
Warning system evaluation: Yield



Total yield of potato plants of different cultivars managed under early warning, fixed schedule and no application strategies during the 2018-2019 to 2022-23 seasons.

- ❖ Tuber yield is closely related to the level of late blight damage on the foliage, thus, under the same condition, the treatment without application shows a lower yield, but there are no differences between the treatments applied with alert or on a fixed schedule.

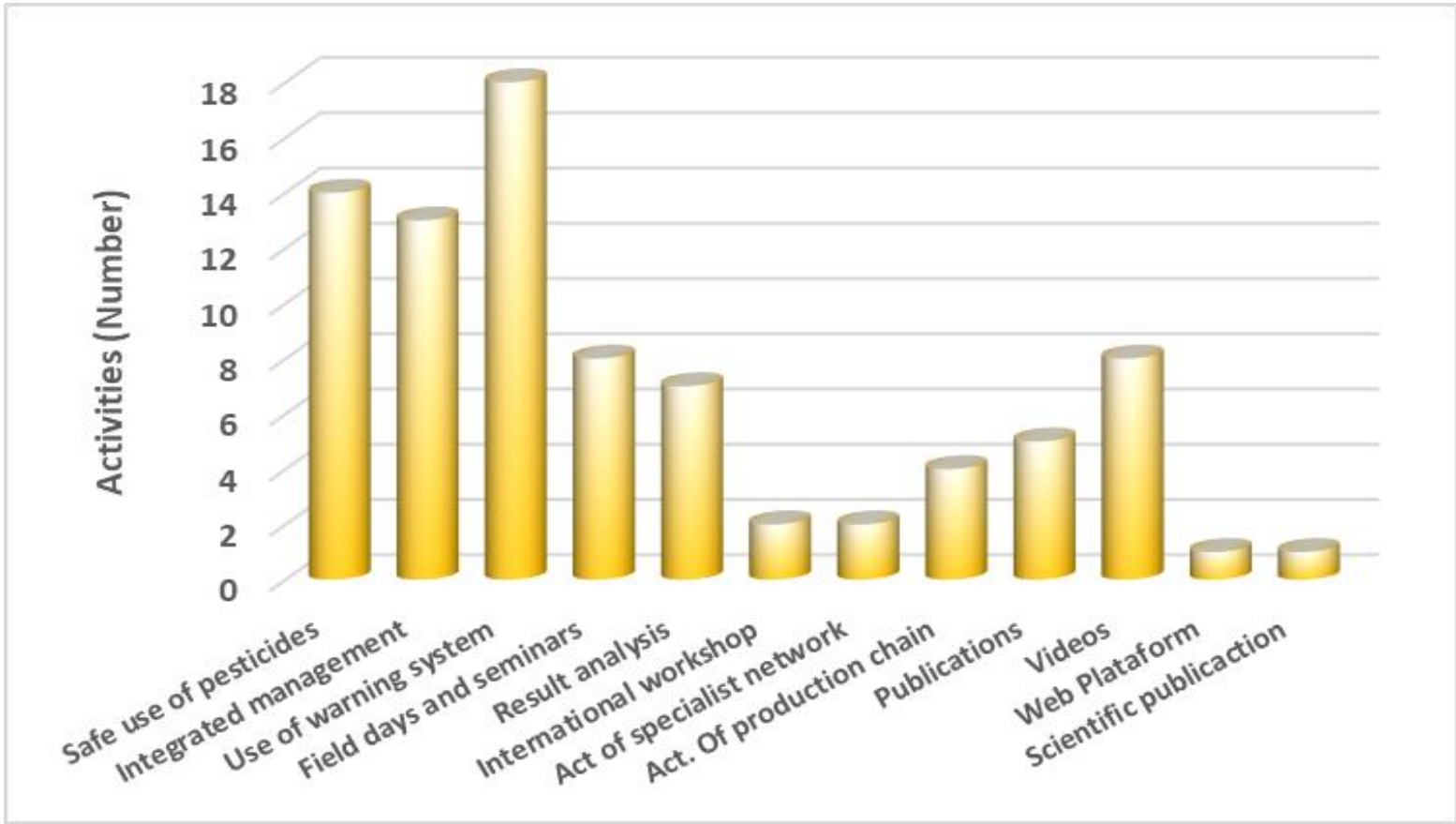
Warning System Impact



Average reduction:

- Amount of application: 53,5 %
- Environmental Impact Quotient: 56,0 %
- Cost of fungicide application: 60,0 %

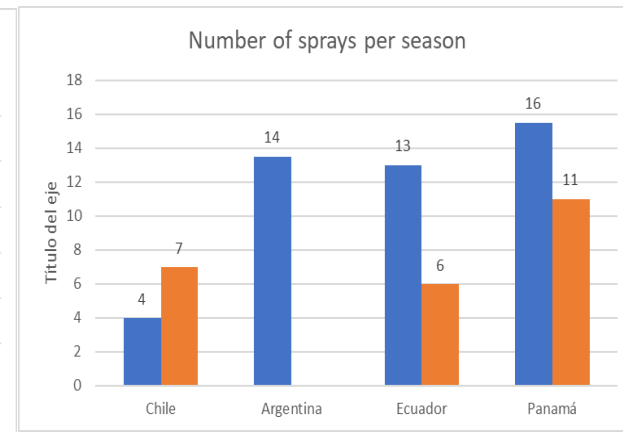
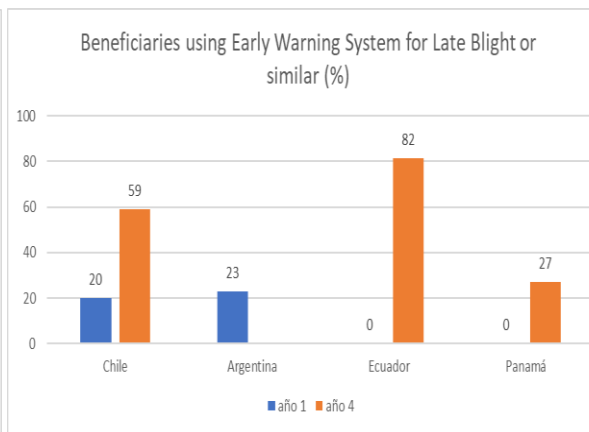
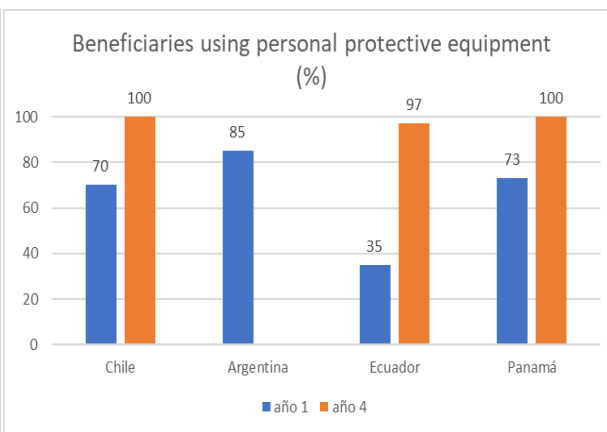
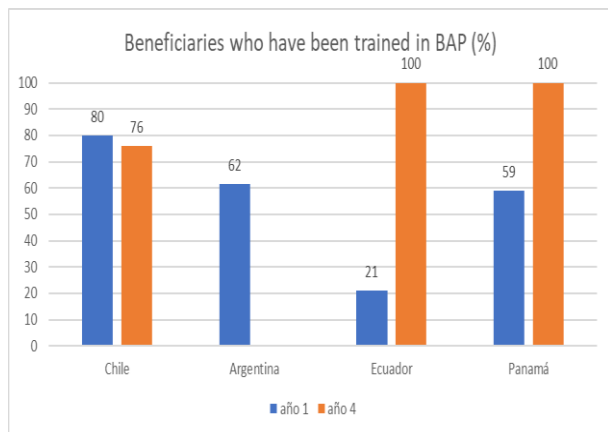
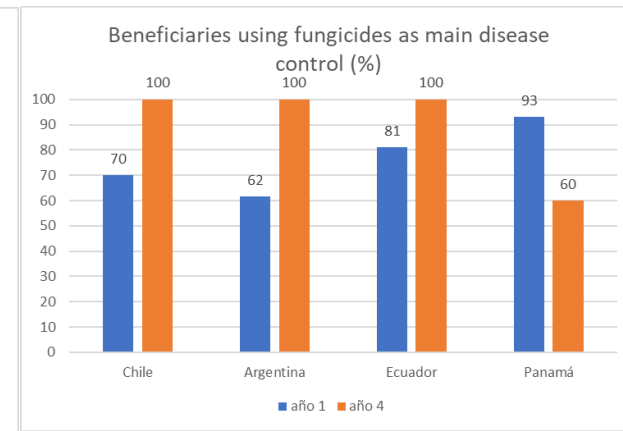
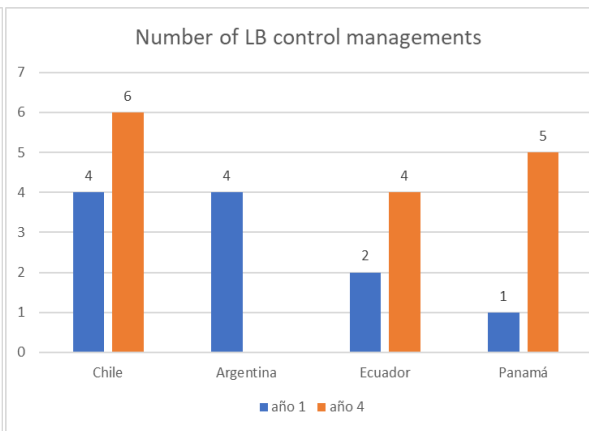
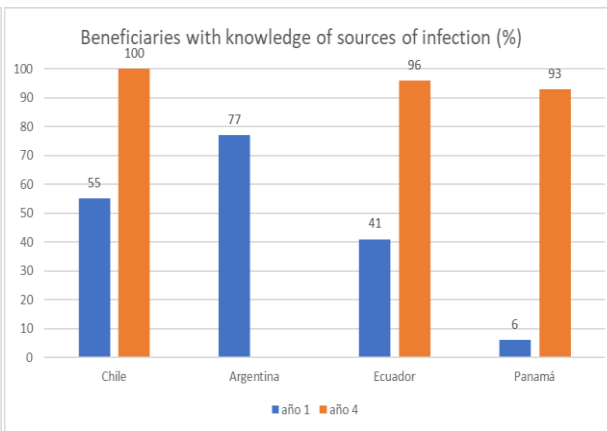
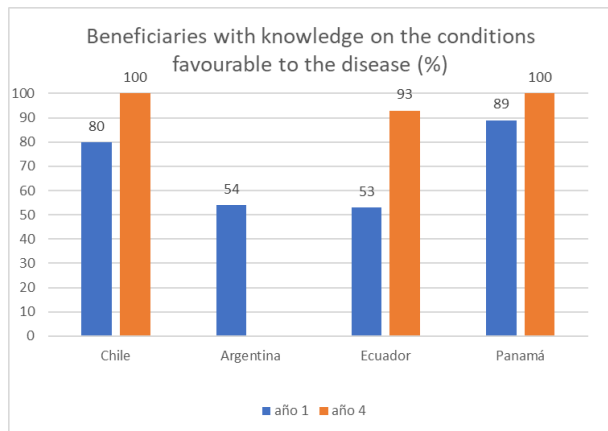
Knowledge dissemination



2.761 people, 41.6% female



Changes in beneficiaries' knowledge about LB and its management at the end of the project. Comparison of survey data year 1 and year 4, by country.



Comments

- The results for validation of the early warning system in the project show that the chemical control strategies with warning-based applications were able to control late blight with a similar level of damage to the fixed-schedule treatment, without affecting yield, especially in moderately resistant and resistant varieties.
- The late blight control strategy using early warning reduced the number of applications, environmental impact index (EIQ) and fungicide costs by 53%, 56% and 60% on average, compared to a strategy with fixed-schedule applications.
- The varietal resistance evaluations show that there is a great variability in the response of the cultivars evaluated, whose information is of great relevance to develop an integrated management package for late blight.



Comments

- The use of warning systems as a control strategy for late blight reduces the severity of LB and contributes directly to the economy and health of farmers and their families.
- The dissemination of knowledge was carried out with the entire production chain, with the participation of 2,761 people, 41.6% of whom were women (1,148 women and 1,613 men).
- The use of information based on early warnings helps farmers to carry out chemical control in a timely and efficient manner and only when necessary.
- Thus, this information, together with training in integrated management and best agricultural practices, promotes climate change adaptation and mitigation for the sustainable intensification of potato production.

Acknowledgments:

- FONTAGRO: ATN/RG 16678-RG.
<https://www.fontagro.org/new/proyectos/alerta-temprana-para-el-manejo-del-tizon-tardio-d/en>



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iacuna@inia.cl

