

WEEDS KILL WEEDS

Dr. Gustavo Sosa



INBIOAR

WE DISCOVER | UNA EMPRESA DEL GRUPO ROSENTAL



Current complex context

SEVERAL FACTORS ARE INCREASING OPPORTUNITIES FOR CROP BIOPROTECTION



The growing world population increases the demand for food.



Stricter restriction policies and environmental laws.



Health and environmental awareness.



Environmental pollution.



Waste related to the production and application of chemical pesticide inputs.



Herbicide-resistant weeds, new MoAs are badly needed.

INBIOAR APPROACH



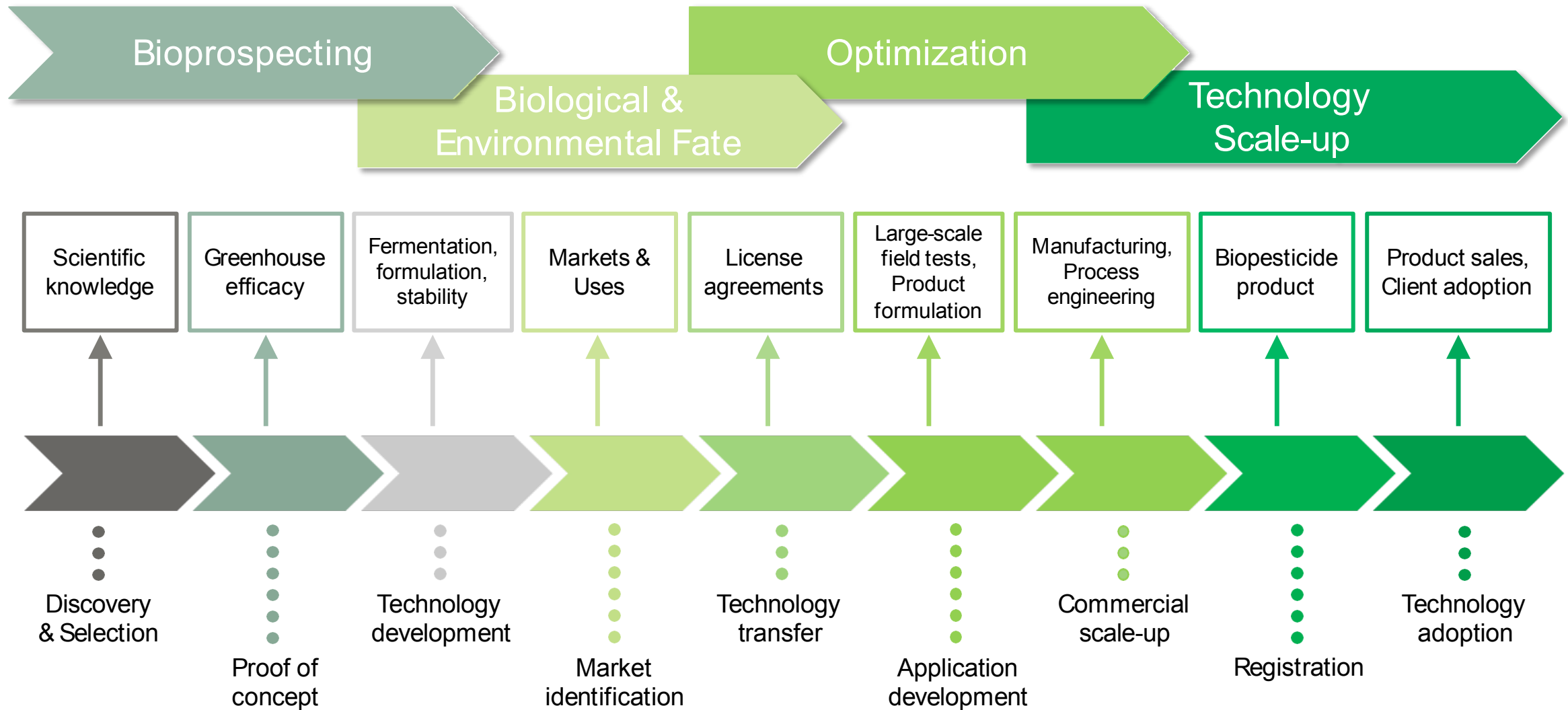
Our Commitment

WE ARE COMMITTED TO A MORE SUSTAINABLE WORLD.

Our botanical ingredients contribute to integral crop protection practices and to the achievement of SDG:



Development of crop bio-protection products: we focus on the initial phase



METHOD: plant bioprospecting



PLANT SAMPLING

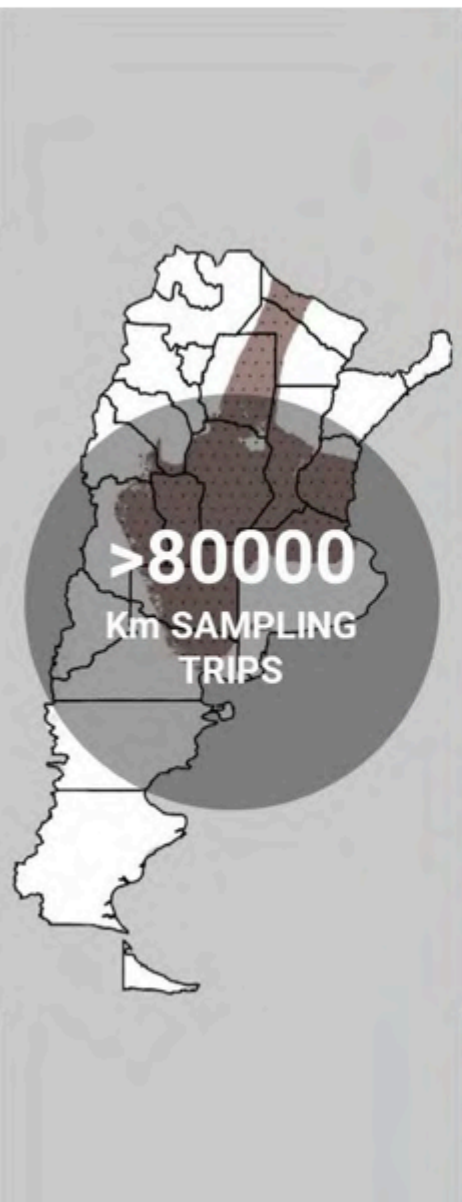
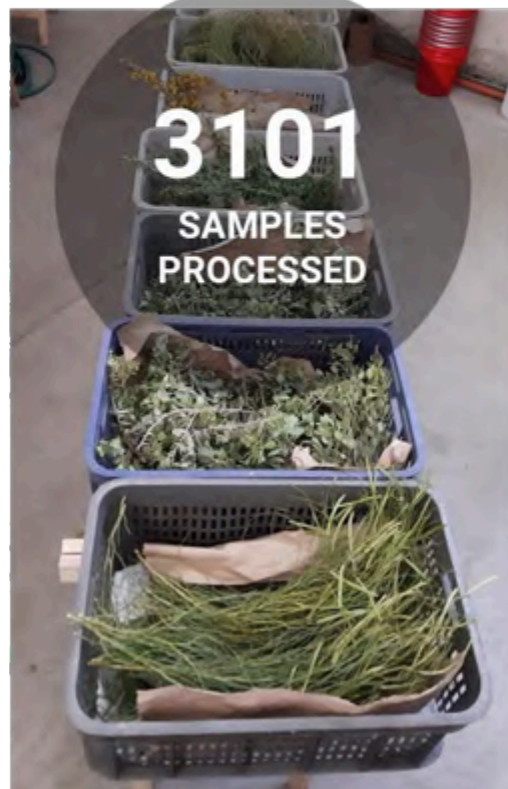
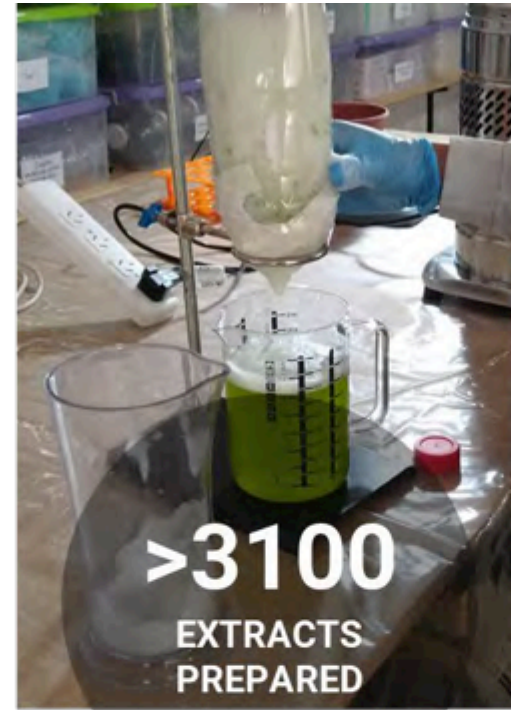


PROCESSING



EXTRACTS & TESTING

OUR EXPERIENCE: Scientific knowledge and a rigorous process of evaluation and selection of naturally occurring herbicidal compounds produced by plants.



1235

PLANT SPECIES
COLLECTED &
IDENTIFIED

3101

SAMPLES
PROCESSED

>3100

EXTRACTS
PREPARED

>4500

PHYTOTOXICITY
BIOASSAYS
PERFORMED

METHOD: plant sampling



Identification of strategic regions



METHOD: Extracts Testing & Early Development



**Testing &
Selection**

**Chemistry a.i.
isolation &
identification**

**Biology &
MoA**

**IP /
Technology
transfer**

**Large-scale
tests
Registration**



Early growth &
germination



Facilitated translocation



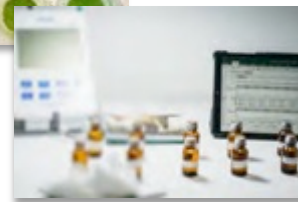
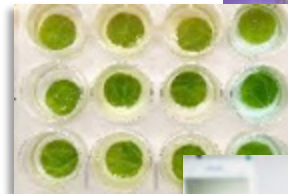
POST-emergence
activity



Bioassay-guided
fractionation



Mode of
action



Molecular target



Literature review



Intellectual Property



OUR RESULTS: CROP PROTECTION LEADS/ HITS/ prototypes



INBIOAR-
H002-AR

- Herbicide (contact)
- Plant metabolite



INBIOAR-
H001-AR

- Herbicide (contact)
- Plant natural products from *Ammi visnaga*



INBIOAR-
H004-AR

- Herbicide (progressive post-emergence effect)
- Plant extract



INBIOAR-
F001-AR

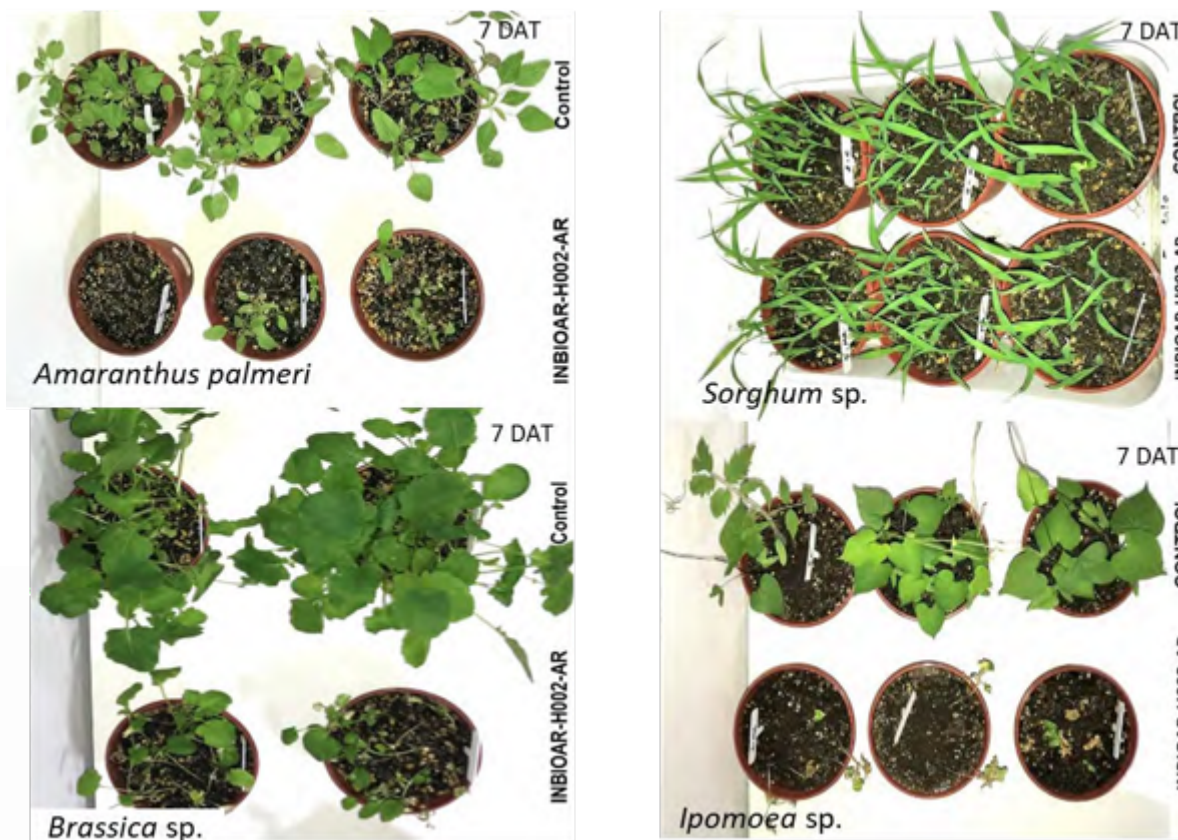
- Antifungal (preventive, elicitor)
- Plant extract

INBIOAR-H002-AR: Herbicide (contact) plant metabolite



This is a plant secondary metabolite. The crude extract was studied and the pure molecule showed higher efficacy on weeds.

Post-emergence application on different species:



dicotyledonous species were more sensitive than the monocotyledonous ones.

INBIOAR-H001-AR: Herbicide Plant natural products from *Ammi visnaga*



The active ingredients (khellin and visnagin) were isolated and chemically identified. Initial studies on the potential mode of action were performed.

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Article

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Khellin and Visnagin, Furanochromones from *Ammi visnaga* (L.) Lam., as Potential Bioherbicides

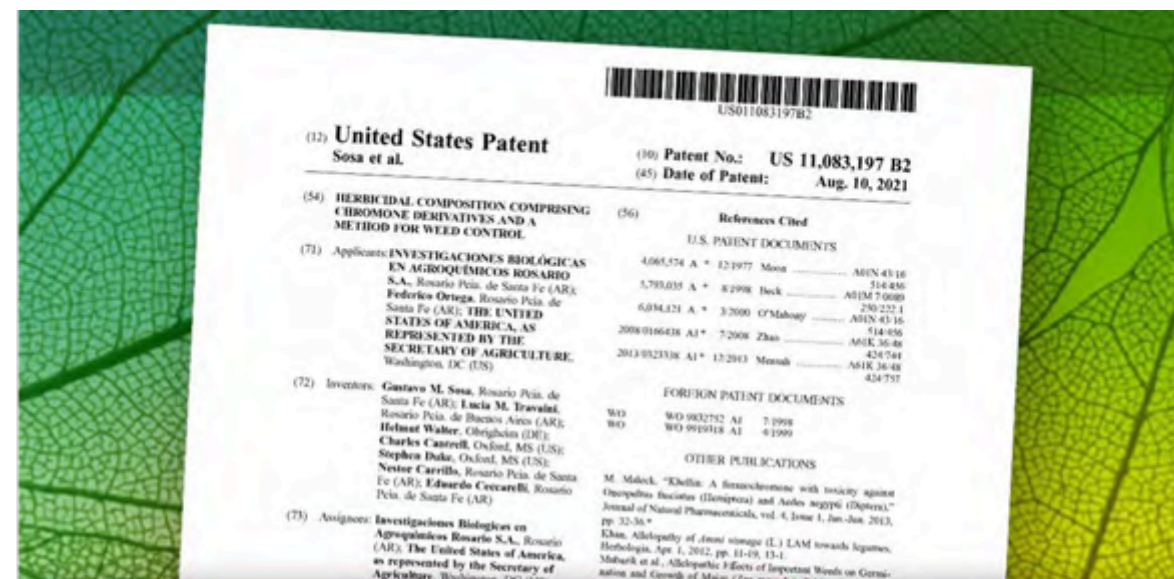
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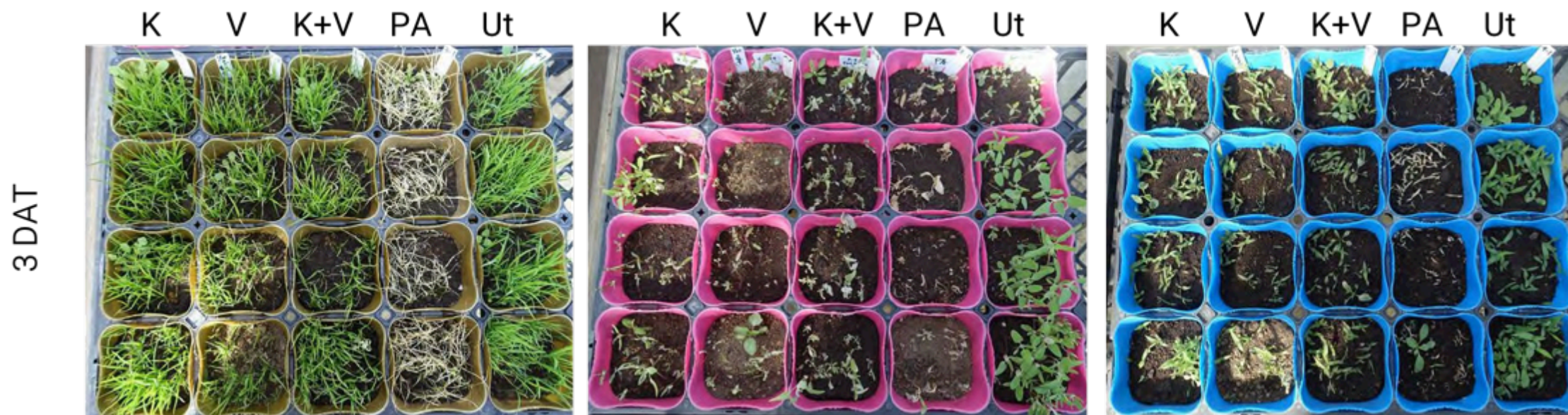
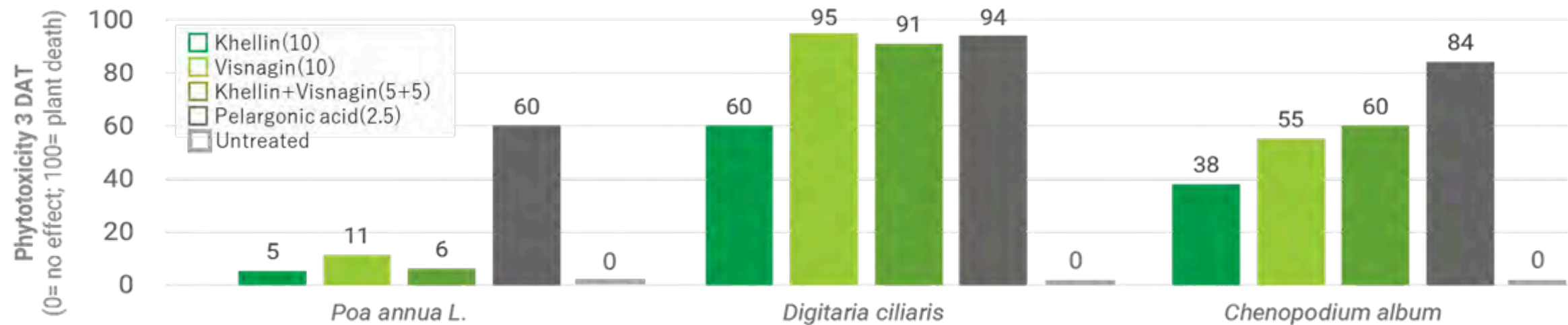


US Patent filed jointly with the USDA on bio-herbicide active ingredients issued



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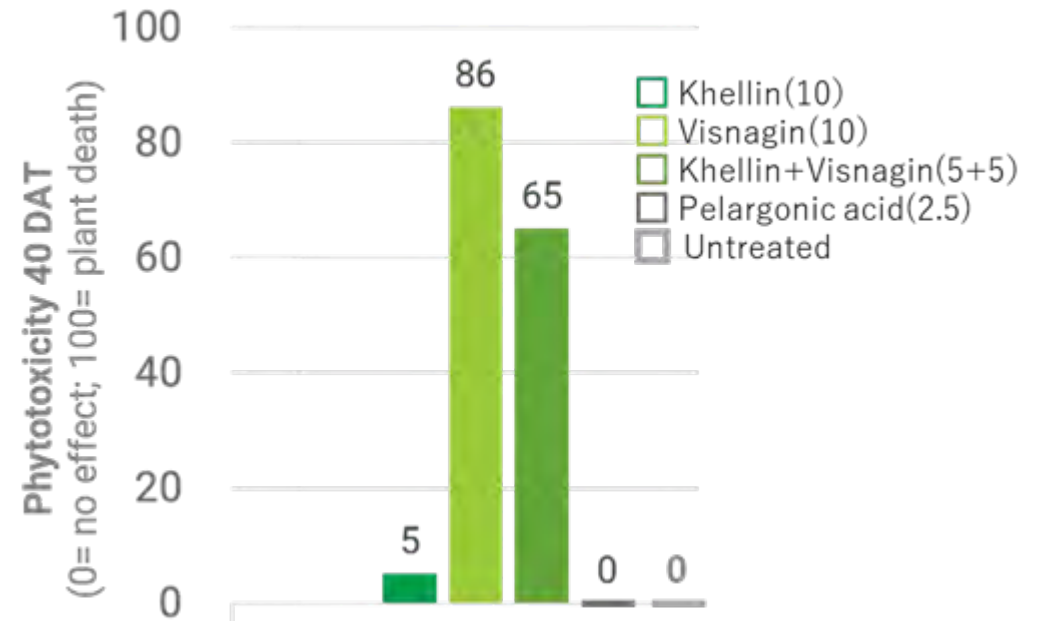
INBIOAR-H001-AR: Herbicide Plant natural products from Ammi visnaga



Herbicidal activities of khellin + Visnagin were observed against *Digitaria cliaris* and *Chenopodium album*.



Herbicidal efficacy of soil application (Pre-emergence)



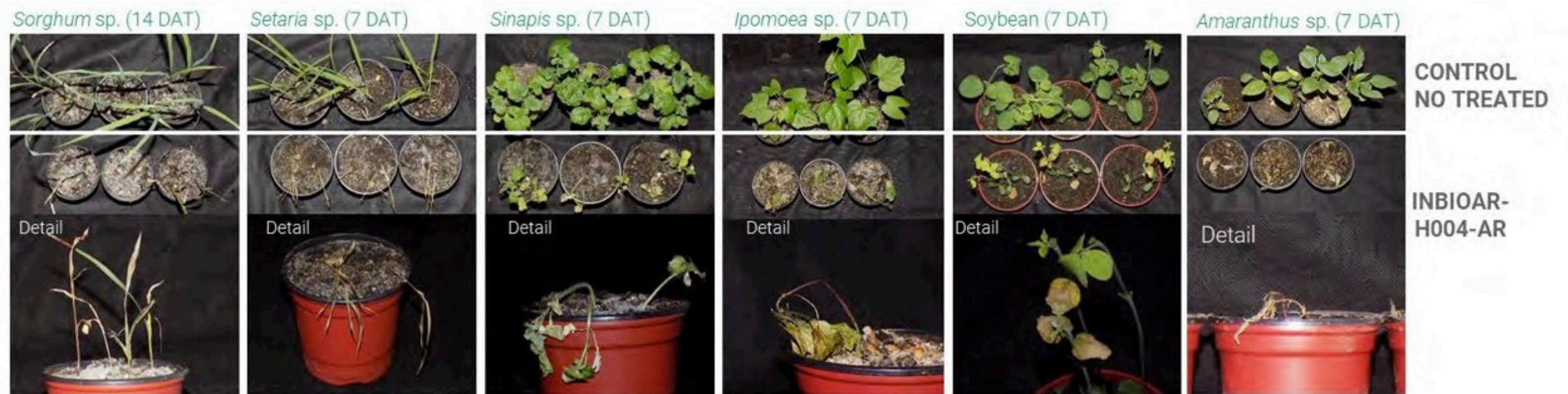
PRE herbicidal activity of Visnagin was observed against *Digitaria ciliaris* and *Chenopodium album*.

INBIOAR-H004-AR: Herbicide plant extract (progressive post-emergence effect)

Different species were differently affected.



Results on the most affected species:



INBIOAR-H004-AR: Herbicide plant extract (progressive post-emergence effect)

Different species were differently affected.



Results on moderated or not affected species:

Trifolium (7 DAT)

Lettuce (7 DAT)

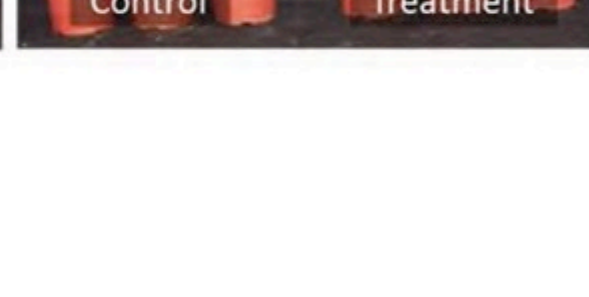
Corn (7 DAT)

Lolium sp. (7 DAT)

Oat (7 DAT)

CONTROL NO
TREATED

INBIOAR-
H004-AR



POST Greenhouse trial INBIOAR-H004-AR: different rates and adjuvants tested



% of control or phytotoxicity at 7 DAT

Testing sample	Adjuvant	Rate (g ai/ha)	Triticum aestivum (winter wheat)	Triticum aestivum (spring wheat)	Zea mays (maize)	Glycine max (soybean)	Echinochloa crus-galli	Setaria viridis	GRASSES (gramíneas)	Lamium amplexicaule	Convolvulus arvensis	Capsella bursa pastoris	Fallopia convolvulus	Matricaria chamomilla	Erigeron canadensis	Chenopodium album	Galium aparine	Amaranthus retroflexus	Amaranthus tamariscinus	Ambrosia artemisiifolia	Xanthium strumarium	Sida rhombifolia	Ipomoea hederacea	Solanum nigrum	Abutilon theophrasti	BROADLEAF WEEDS (malezas de hoja ancha)
INBIOAR-H004 (375 l/ha)	0,5% Tween 20 (= 1875 g/ha)	40000	80	30	45	90	90	90	90	80	40	95	90	60	95	75	80	90	98	60	60	50	45	85	55	72
		20000	45	10	10	85	50	55	53	20	10	40	20	40	35	10	30	70	98	10	0	10	10	25	10	27
		10000	40	0	0	45	10	85	48	15	0	60	10	20	25	10	10	5	20	10	0	10	0	20	0	13
		5000	10	0	0	20	0	30	15	15	5	10	0	5	5	0	0	5	10	0	0	10	10	5	0	5
INBIOAR-H004 (375 l/ha)	0,5 % Dash	40000	70	15	50	95	80	85	83	95	60	90	70	45	60	30	50	95	98	60	25	65	40	10	0	56
		20000	50	10	10	90	45	85	65	60	10	70	10	30	35	20	35	30	95	10	60	10	40	10	5	33
		10000	30	0	10	60	10	35	23	10	5	10	0	35	25	5	10	10	20	0	20	0	25	-	0	12
		5000	10	0	5	35	5	10	8	10	0	10	0	5	20	5	0	0	0	0	0	0	0	0	0	3
INBIOAR-H004 (375 l/ha)	1 % MSO	40000	70	20	95	95	90	85	88	60	15	90	80	50	80	20	70	80	98	45	60	65	35	80	70	62
		20000	60	10	35	85	40	80	60	70	10	75	0	40	40	0	60	75	65	10	20	10	20	10	20	33
		10000	10	0	25	40	10	40	25	35	10	40	0	40	20	10	40	5	0	10	0	0	5	5	10	14
		5000	0	0	15	20	0	10	5	10	10	10	0	10	10	0	10	10	0	0	0	5	0	10	0	5
Roundup Powermax III 600 g/L SL Glyphosate		720	50	70	60	90	90	95	93	98	50	98	75	98	90	90	75	98	98	90	98	90	85	98	80	88
		360	50	65	40	90	80	95	88	98	20	80	60	95	75	80	70	98	98	90	95	80	80	95	80	81
		180	50	60	35	80	70	75	73	90	10	80	35	95	70	70	65	98	98	90	50	60	75	90	60	71
		90	50	60	10	70	65	70	68	80	0	80	0	70	60	50	55	75	98	70	45	25	35	90	15	53

POST Greenhouse trial INBIOAR-H004-AR: increased rates and % adjuvant tested



% of control or phytotoxicity at 20 DAT

POST			Grasses			Broadleaves			
Testing sample	Adjuvant	Rate (g ai/ha)	<i>Commelina benghalensis</i>	<i>Echinochloa crus-galli</i>	<i>Setaria viridis</i>	<i>Abutilon theophrasti</i>	<i>Amaranthus retroflexus</i>	<i>Euphorbia heterophylla</i>	<i>Geranium pusillum</i>
INBIOAR-H004 (375 l/ha)	1% DASH	60000	100	90	98	100	100	100	100
		30000	75	70	95	55	100	100	80
		15000	10	10	80	10	100	100	10
		7500	0	5	40	0	25	90	0

- POST excellent efficacy of the highest tested rate (60 kg extract/ha) on these seven weeds. With 30 kg, very good activity in the most sensitive weeds, like SETVI, AMARE and EPHHL.
- Early application timings and the adjuvant rate increased improved the control

Main conclusions after Greenhouse trial with INBIOAR-H004-AR:



- The higher the tested rates, the higher the efficacy in certain weeds, some of them with high agricultural impact.
- Among the adjuvants tested, Tween 20 would be the most active, followed by Dash.
- No clear selectivity observed.
- About weed efficacy:
 - ✓ The smaller the weed GS at application, the better control
 - ✓ SETVI was the most sensitive grass, followed by ECHCG and DIGSA
 - ✓ The best activity was observed on CAPBP, POLCO, ERICA, AMARE and AMATA
- Lack of activity at PRE timing (not showed)

INBIOAR-F001-AR: preventive antifungal extract



It prevents potato late blight (*Phytophthora infestans*):
Potato plants were sprayed once with the extract, one day before inoculation.

The infection was reduced on treated potatoes:



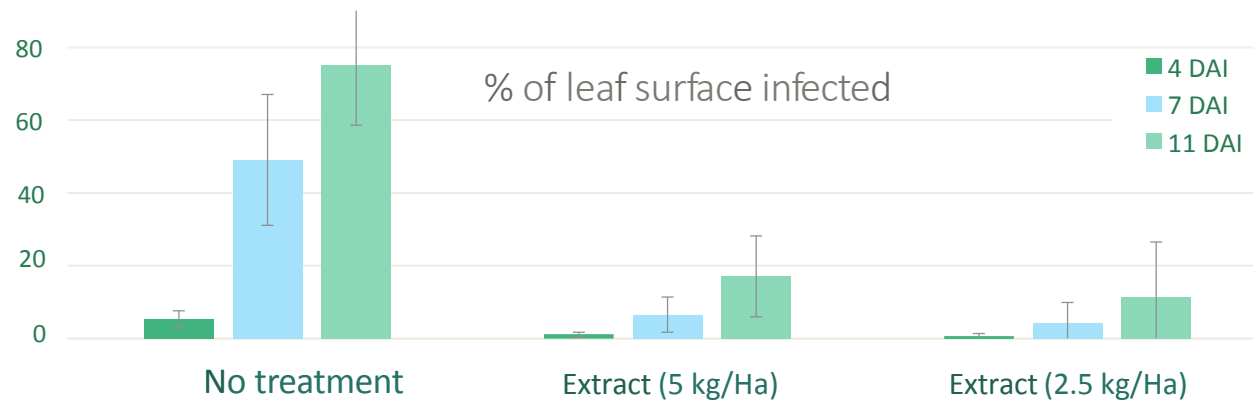
No treatment



Extract (5 kg/Ha)



Extract (2.5 kg/Ha)



Similar results were observed on tomato in a different greenhouse trial:

An aqueous solution of this plant extract showed 85% of disease control by treating plants 3 days before inoculation with *P. infestans*.

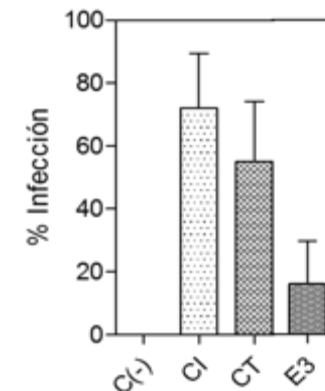
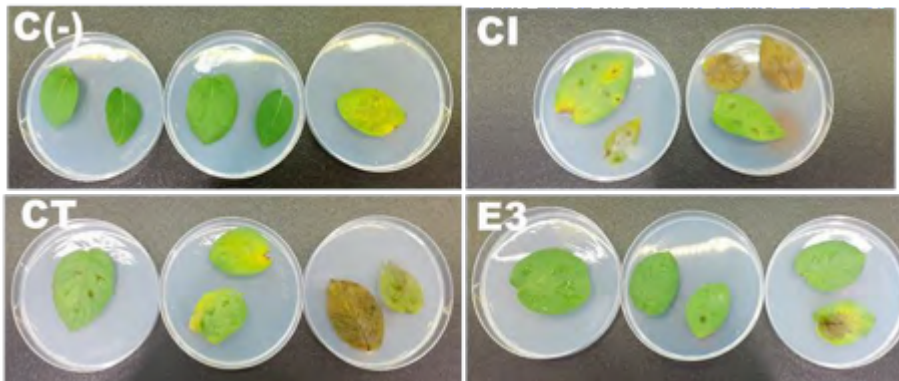
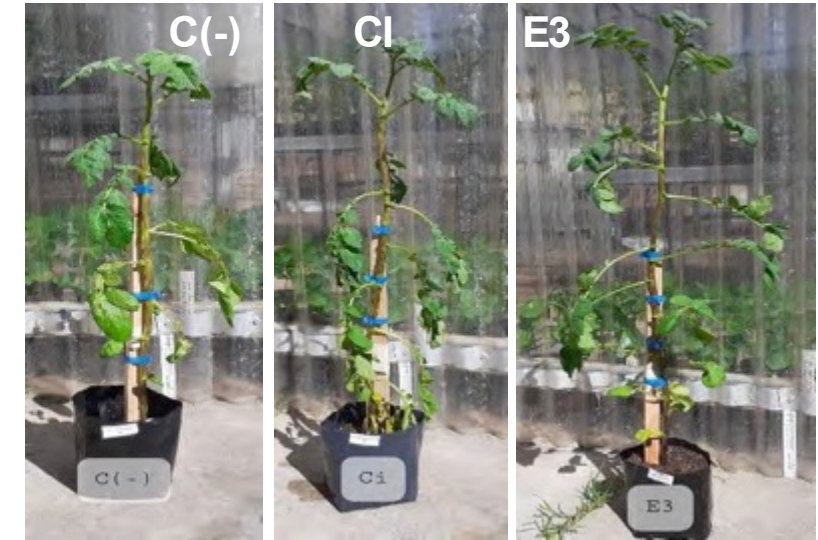
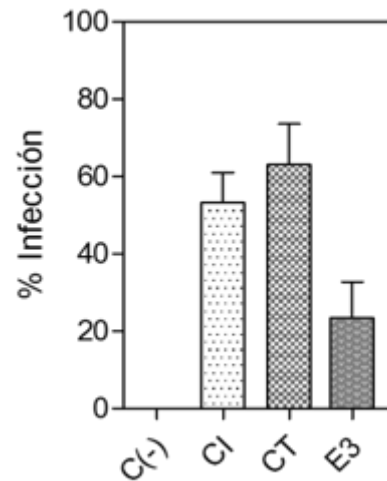
Lab bioassay: Direct effect on sporangia development in Petri dishes not detected.

INBIOAR-F001-AR: preventive antifungal extract



The extract (treatment E3) reduced potato Late blight (*P. infestans*) infection.
MULTI-SPRAYS before inoculation would increase the efficacy.

Results inoculating
sprayed plants:



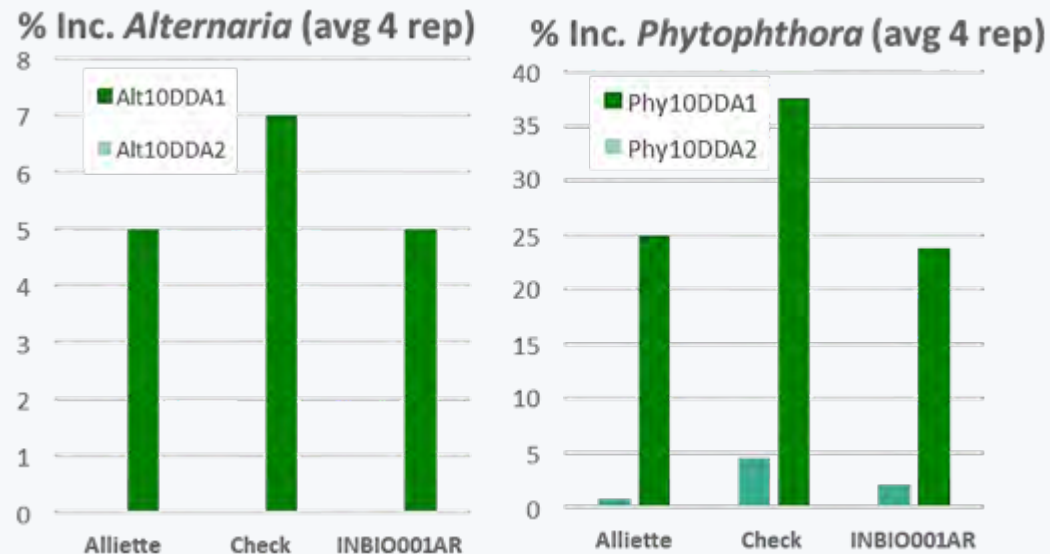
Results inoculating
detached leaves of
sprayed plants

The extract was sprayed 3 times (1.2 kg/Ha each) within a week, 24 hours before inoculation. C(-): no infection, C1: control of infection, CT: control with tween 20 only (because it was used as experimental surfactant).

INBIOAR-F001-AR: Efficacy trials under natural field conditions



On potato crop (Tandil, Bs. As, AR):



Data on the incidence (%) of late blight (*Phy*) and early blight (*Alt*) were collected at: 10DDA1 (10 Days After 1st Application), 10DDA2 (10 Days After 2nd Application)

Ten days after 2nd application, the extract reduced the incidence of Late blight (*P. infestans*) and Early Blight (*Alternaria solani*) under natural field conditions on potato crop.

On sweet peppers for seed production (Chile):

A complete row (>300 plants) was treated
Plants with symptoms were identified (mortality to *Phy* 10-15 pl per week)



The extract reduced the mortality rate to *Phytophthora* sp. (5 plants within 3 months), and plants with initial symptoms recovered and were harvested.



- ✓ **Different drying methods were tested:** Spray-drying system should be considered to produce the extract in larger quantities, as it is more convenient than lyophilization.
- ✓ The moderate or weak direct antifungal effect of the extract detected in laboratory bioassays, would not explain the results observed in plants. In addition, efficacy appears to be higher when tested on plants compared to detached leaves. This may be related to a **potential elicitor or stimulant effect of plant defenses** of this extract. Preliminary studies (data not shown) indicated that the extract alone in the absence of infection would be able of triggering biochemical responses, some of them related to stress conditions such as those the pathogen triggers.

Our team



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Weeds Kill Weeds





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