SUStaINable use of bioactive compounds from *Brassicaceae* and *Solanaceae* wastes for CEReal crop protection (SUSinCER)

C. Lanzanova[1], D. Pacifico[2], F. Nicoletti[2], R. LoScalzo[3], E. Pagnotta[2], L. Bassolino[2], L. Ugolini[2], L. Righetti[2], A.M. Mastrangelo[4], D. Marone[4], D.B.M. Ficco[4], M.A. Russo[4], S. Locatelli[1], F. Modica[1], V. Battaglia [5], E. Lahoz [5], C. Balconi[1]

[1] CREA Centro di ricerca di Cerealicoltura e Colture industriali, Via Stezzano 24 Bergamo, Italy
[2] CREA Centro di ricerca di Cerealicoltura e Colture industriali, Via Corticella 133 Bologna, Italy
[3] CREA Centro di Ingegneria e trasformazioni Agroalimentari, Via Venezian 26 Milano, Italy
[4] CREA Centro di ricerca di Cerealicoltura e Colture industriali, S.S 673- Km 25,200 Foggia, Italy
[5] CREA Centro di ricerca di Cerealicoltura e Colture industriali, Via Torrino 2, 81100 Caserta, Italy
E-mail: chiara.lanzanova@crea.gov.it

Bioactive compounds from Brassicaceae and Solanaceae wastes for cereal crop protection

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INTRODUCTION

Defatted seed meals of oleaginous *Brassicaceae*, such as *Eruca sativa*, and potato peel are excellent sources of biomolecules with applications in crop protection.

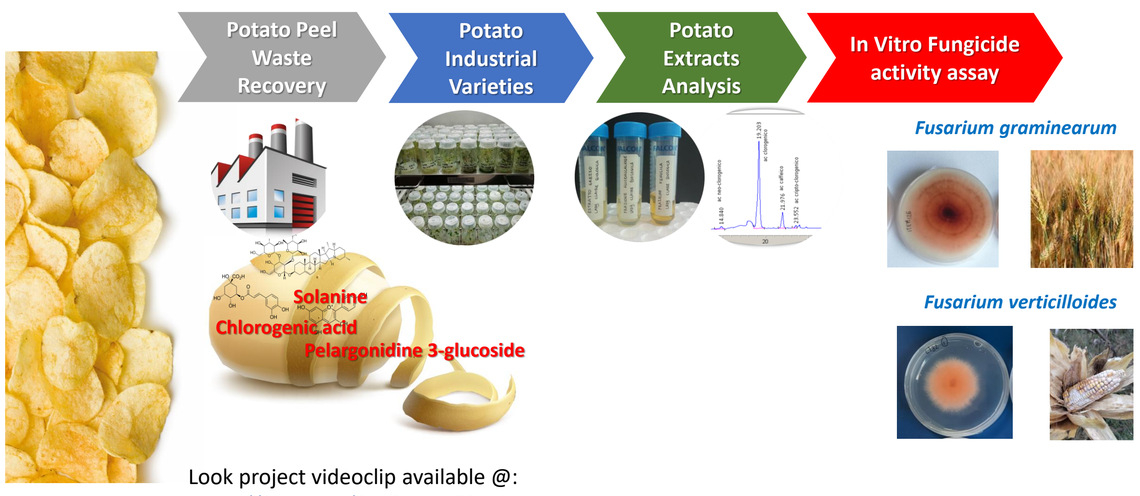
Glucosinolates from *Brassicaceae* and **glycoalkaloids** from potato have been proven to be effective against pests like bacteria and fungi.

SUSinCER project aims to investigate the biological activity of these secondary metabolites against the development of fungal pathogens and mycotoxin production by fungi that contaminate maize and wheat, the molecular basis of their synthesis, and their mechanisms of action.

Possible genetic and biotechnological strategies are presented to increase their content in plants. The application of these bioprotectors will deal with new global challenges, such as reducing food waste and increasing sustainability and food safety for the consumer, in a circular economy perspective.

During the first year of project, a radial growth inhibition assay has been performed ***in vitro*** to evaluate the effect of different bioactive compounds on *Fusarium verticillioides* and *Fusarium graminearum* growth, important mycotoxigenic fungal pathogens responsible for maize and wheat rot**. In field** activities are ongoing for wheat and maize to study the effect of bioactive compounds on resistance to fungal diseases and agronomic performance.

SOLANACEAE

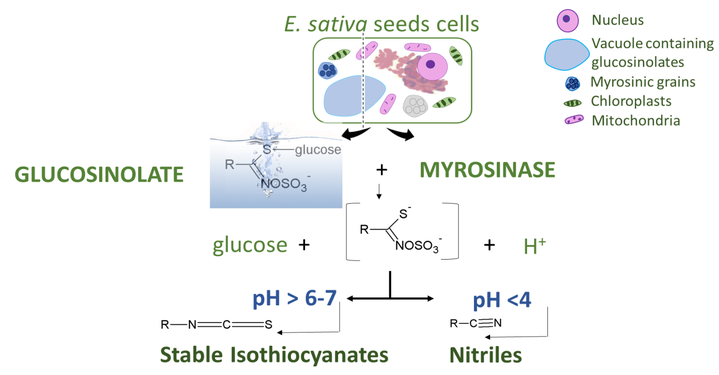


Look project videoclip available @:
https://youtu.be/6ea0MsbL53g

The use of bioactive molecules, such as glycoalcaloids, extracted *Solanum tuberosum* wastes is under investigation. Indeed, it could contribute to food waste reduction by implementation of new agro-industrial systems satisfying the requirements of the circular economy. The aim is using peels recovered from industrial chips production in order to obtain raw extracts to employ as bioprotectors reducing the impact of pathogens, pests, biotic stresses on cereal crop quality and yield.

BRASSICA oilseed value chain

From plant selection to exploitation of co-products



The role of the enzyme myrosinase: from glucosinolates to bioactive isothyocyanates

Glucosinolate enriched extracts and Glucosinolate purification

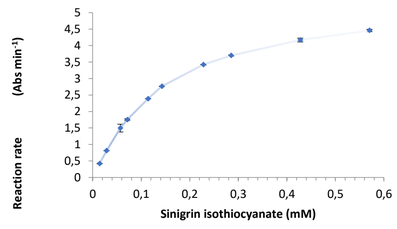
Preparation of glucosinolate enriched extracts. According to Testai et al. 2022

Isolation of glucosinolates by means of a first step of anion exchange chromatography According to Citi et al. 2019

Improvement of glucosinolate purity by means of gel-filtration (XK 26/100 column packed with with Sephadex G10).According to Franco et al. 2016

Myrosinase purification

According to Pessina et al. 1990



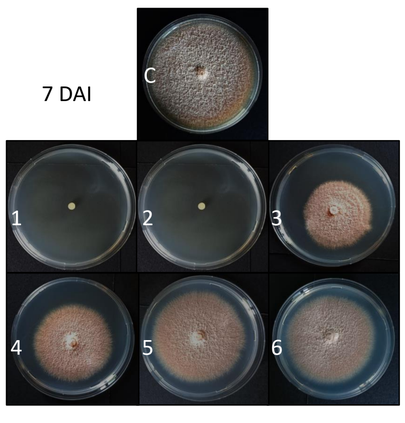
Myrosinase-glucosinolate reaction Spettrophotometric assay

Products for *in vitro* trials and biofumigation

From **defatted seed meals** we obtained: 1 powdered extract enriched in sinigrin (from *Brassica carinata* seeds), 539 µmol g^{-1}; 1 powdered extract enriched in glucoerucin (from *Eruca sativa seeds*), 487 µmol g^{-1}; sinigrin (from *Brassica nigra* seeds) and glucoerucin (from *Eruca sativa* seeds) with a HPLC purity >90%. From *Sinapis alba* seeds we obtained 10 mL of Myrosinase 21,9 U/mL. Formulations for in fields trials were also prepared, starting from commercial products based on *B. carinata* defatted seed meals from *Nutrien Italia SpA*.

IN VITRO ANTIFUNGAL ACTIVITY

Cultures of *Fusarium verticillioides* and *Fusarium graminearum* were grown on PDA medium at 25°C light/dark and subcultured each week. On the surface of 9-cm diameter Petri dish containing 15ml of PDA different metabolites were spread with a sterile loop. The inoculum was a 5 mm diameter core cut from the perimeter of a fresh culture with a sterile cork borer and centrally placed on the plates. Cultures were incubated at 25°C for 6-7 days up to complete development of mycelium on the agar surface. Radial growth of the pathogen was measured from 3 to 7 Days After Inoculation. Fungal toxicity was recorded as percentage of colony diameter inhibition and calculated according to Amadioha (2000).



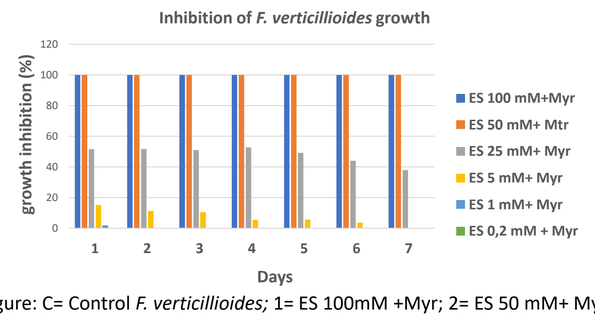


Figure: C= Control *F. verticillioides;* 1= ES 100mM +Myr; 2= ES 50 mM+ Myr; 3= ES 25 mM+ Myr; 4= ES 5mM+Myr; 5= ES 1 mM+Myr; 6= ES 0,2 mM+Myr

Results show an example of *F. verticillioides* growth inhibition with different concentration of *Eruca sativa* extract from 1 to 7 DAI (Days After Inoculation). 100 and 50 mM of extract are able to reduce completely the fungal growth; 25 mM reduces the growth of about 40-50% while with 5 mM of extract an inhibition of 10-15% can be observed within 3 days. No inhibition is observed with the lower concentrations

IN VIVO FIELD EXPERIMENT

During 2022 an *in vivo* field assay with a solid and liquid treatment of Brassica extracts has been set up to study the effect of bioactive compounds on resistance to fungal diseases and agronomic performance. The analysis of the results are in progress.

CONCLUSIONS

Some secondary metabolites from defatted seed meals of oleaginous *Brassicaceae* and potato peel are able to contrast the development of fungal pathogens inhibiting their *in vitro* growth, results appear to be promising.

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