COLD PLASMA PROCESSING OF SEEDS AS NON-CHEMICAL, GREEN TECHNOLOGY FOR PRODUCTION STIMULATION

Iuliana MOTRESCU, Mihai Alexandru CIOLAN#, Anca Elena CALISTRU, Gerard JITĂREANU

Research Institute for Agriculture and Environment
Iasi University of Life Sciences, Romania
imotrescu@yahoo.com, +40 232 407 527

#Research Center on Advanced Materials and Technologies,
Alexandru Ioan Cuza University of Iasi, Romania

Introduction

Plasma agriculture ⇆ sustainable agriculture

⇉"focuses on producing long-term crops while having minimal effects on the environment"

→ reduce the use of fertilizers
→ minimize the use of pesticides
→ maintain economic stability of farms
→ help framers improve their techniques and quality of life

Use of nothermal plasma as green technology aims:

① Economic impact → reduce the germination and development time
→ enhance the properties of the plants
→ increase the shelf-life

② Producers and consumers' safety
→ no-chemicals used
→ inactivation of microorganisms

Motivation

Why sprouts? – very popular in some countries (especially from Asia)

– contain a wide range of bioactive compounds = benefic for human health

– many outbreaks are known (e.g. *Listeria, E. coli, Salmonella*)

Why plasma treatment? → plasma is a powerful chemical reactor

→nonthermal plasma – can be used for biological interfaces

→ reduce the costs of sprout production

→ increase the consumption safety and viability on shelf

Purpose

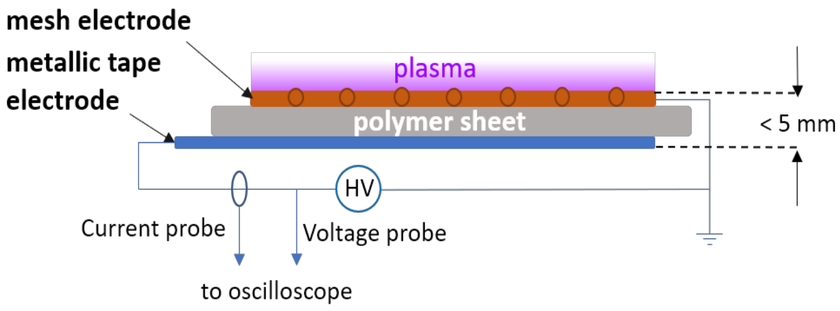
➔ **Address the needs of local small vegetable farmers for green technologies**

✓ **Detailed study from seed modification to sprouts production**

✓ **Contribution of reactive species on the modifications**

✓ **Differences between species**

Experimental design



Schematic representation of the surface dielectric barrier discharge (sDBD) for seeds treatment

sDBD with flexibile electrode configuration

-variable power supply 0-18kV (HVA 18K603AC, Japan)

-10kHz signal

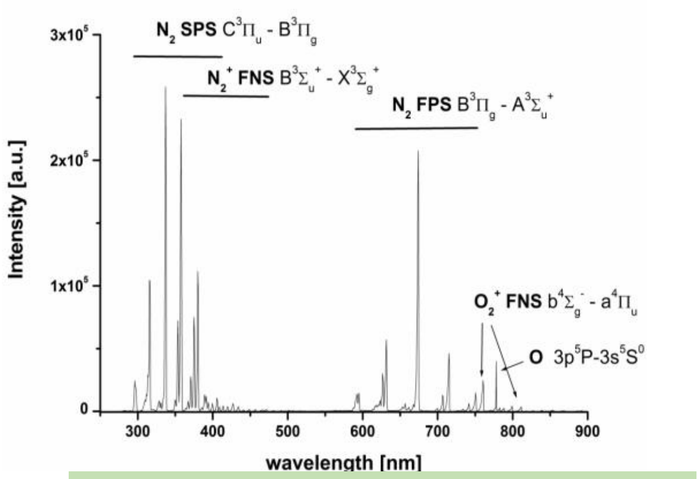
-direct treatment (seeds placed on the upper electrode)

-with cover (the device is covered to keep the reactive sp.)

-reactive species are present (

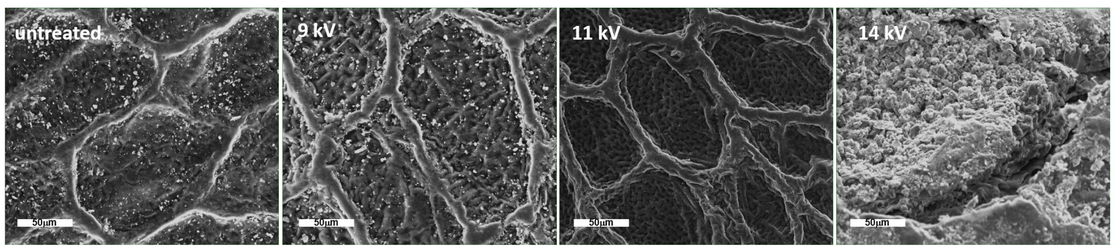
Seeds:

- *Bassica oleranceae* L. var. *italica* – broccoli



Emission spectrum of sDBD in atmospheric air

Seeds analysis



ESEM images of seeds surfaces (untreated and treated in direct plasma 30 s with sDBD at different voltages)

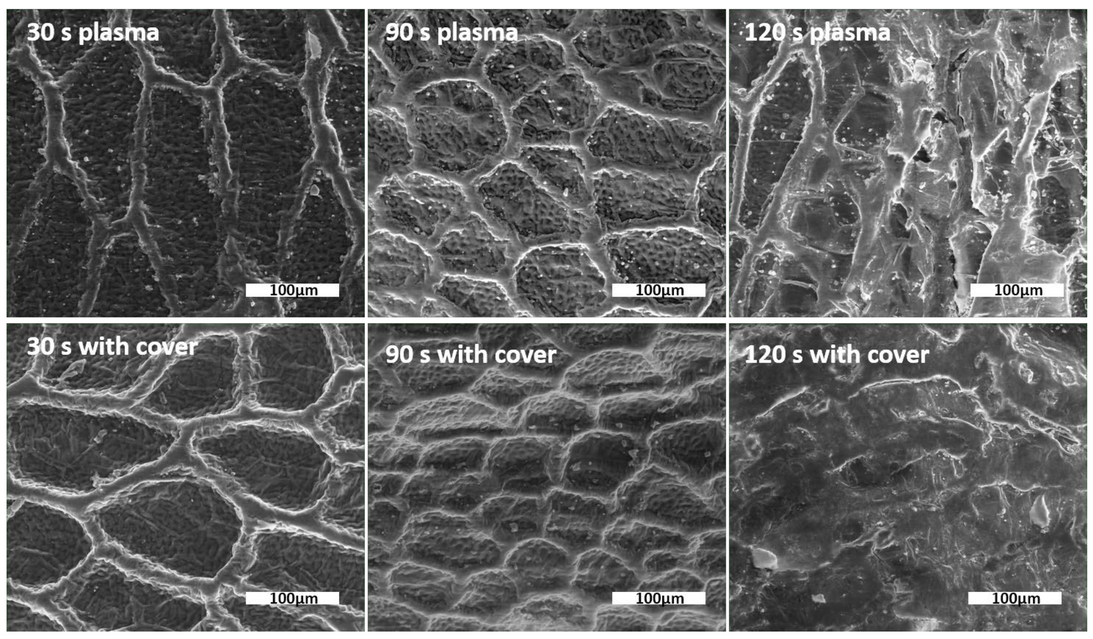
→for direct treatments the damage increases with the applied voltage for the same exposure time

→ slight disintegration of the cell walls on the outer epidermis

→irregular shaped agglomerations

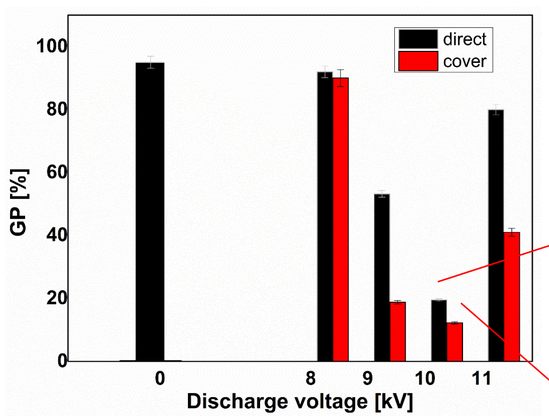
→morphological changes in the seed coat structure

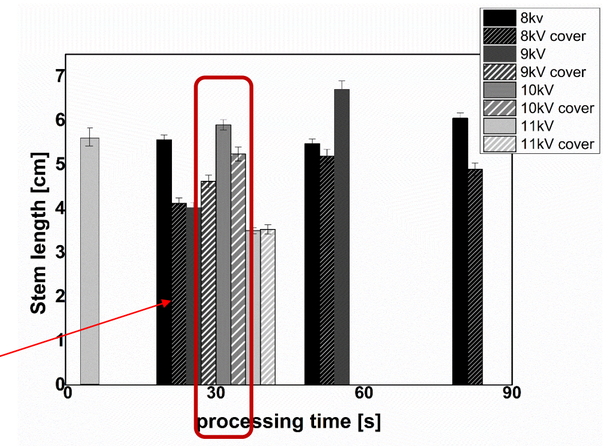
→much stronger effects in the case of concentrated reactive species



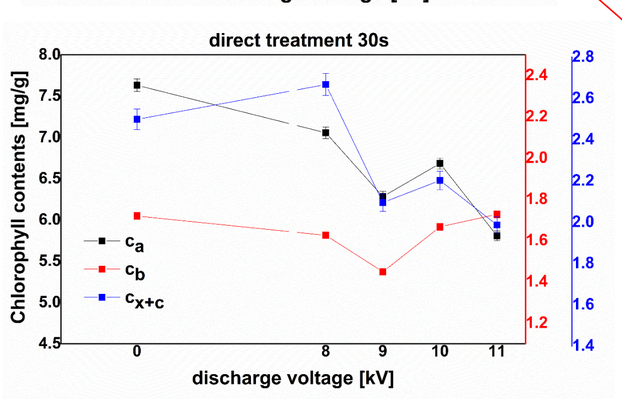
ESEM images of seeds surface (different processing times, 11 kV sDBD)

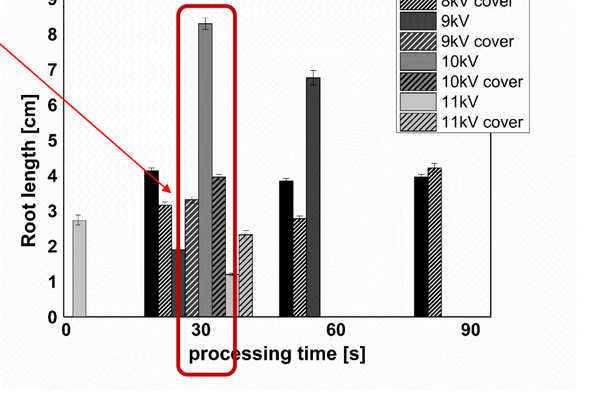
Germination potential for broccoli sprouts seeds in 30 s to sDBD produced with different voltages with and without cover (p<0.005).



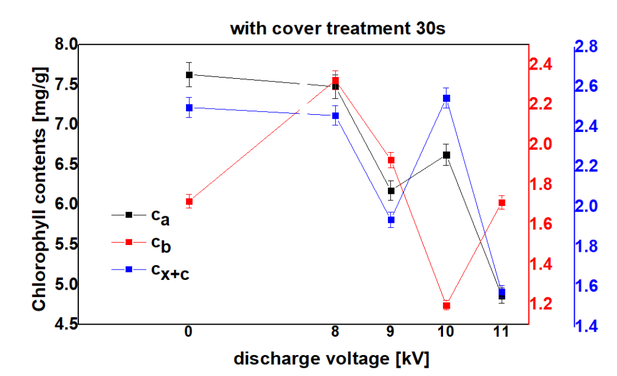


Slight (but significant, p<0.05) **growth stimulation**





Chlorophyll contents



- decrease of chll a/chll b ⇉ indicator of photosynthesis efficiency (negative influence)
- In all cases the sprouts are influenced by the treatment;
- The changes might be responses induced by stress responses towards the reactive species

Conclusions

→ exposure to sDBD can both lead to **stimulation of germination and plant growth**, but can also have a **negative impact** on plant development

→ the modifications are stronger in the case of concentrated reactive species exposure

→plasma can be applied as green technology for growth stimulation of plants