Interreg Italia–Österreich

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CEDRIC

BEST PRACTICE 2

Easy bio-inoculation:

Seed coating and biochar charging

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The CEDRIC project focuses on the transplantation and adaptation of microbiomes across distinct locations. The project's strategy involves treating barley seeds with microbiomes that have been collected, analysed, and isolated from agricultural fields in various locations throughout Northern Italy and South Tyrol. Furthermore, non-treated seeds were placed in soil along with biochar. This biochar serves as carrier and was charged either with a non-microbial biostimulant and the isolated microbiomes, or with the isolated microbiomes alone.

Material preparation:

- *Seeds:* Seeds are sterilized in a 2% sodium hypochlorite (NaClO) solution for 10 minutes and rinsed four times with deionized sterile water.
- *Microbial suspension*: Prepare a concentrated microbial suspension at 1×10^7 CFU/mL.
- *Biochar*: Biochar (particle size: 0.5–1.5 mm) was pre-loaded with 10% liquid biostimulant and dried at room-temperature. Non-loaded biochar was used as the control and in treatments involving only microbial suspension.

1. Seed Treatment:

Seeds are treated at a ratio of 1 mL of microbial suspension per gram of seed.

- Immerse sterilized seeds in the microbial suspension (1×10^7 CFU/mL) and gently rotate until the suspension is fully absorbed.
- Dry the treated seeds in a laminar flow hood to prevent premature germination and contaminations.
- Once dried, the seeds can be used immediately for sowing or stored in a cool, dry place for up to one month.

Seed Coating Strategy

Seed coting is the process of applying exogenous materials (pesticides, fertilizers, non-microbial biostimulants, or beneficial microorganisms) onto the seed surface to protect plants, reduce environmental stress, and enhance growth. This method allows precise application of active ingredients even at partial rates.

Materials Used:

- **Binders**: Ensure adhesion and cohesion of the coating; examples include methylcellulose, polyethylene glycol, chitosan, polyvinyl alcohol, and gum Arabic.
- **Fillers**: Powders that modify seed shape, size, and weight, e.g., bentonite, calcium carbonate, talc, sand, diatomaceous earth.
- **Active ingredients**: Protectants (fungicides, pesticides, insecticides), nutrients, symbionts, or soil adjuvants. Equipment:
- **Rotating pan**: Seeds rotate in a sloped pan while liquids and powders are applied; widely used for uniform coating.
- **Fluidized/spouted bed**: Airflow suspends seeds while atomized coating is applied; ideal for film coating and surface incrustation.
- **Rotary coater**: Cylindrical drum with rotating disk for pelleting and film coating; ensures even application.

Coating Types:

- **Dry powder coating**: Seeds mixed with powders, often for microbial treatments, then dried
- **Seed dressing**: Thin layer of active ingredients using low dosages; mainly chemical protectants.
- **Film coating**: Thin (<10% seed weight) layer of pigments, polymers, or fungicides; seed size unchanged. Encrusting: Combines liquids and solids for complete coverage; preserves seed shape. Pelleting: Coating with inert materials (vermiculite, kaolin, talc) to produce larger, uniform,and spherical; ideal for very small seeds.

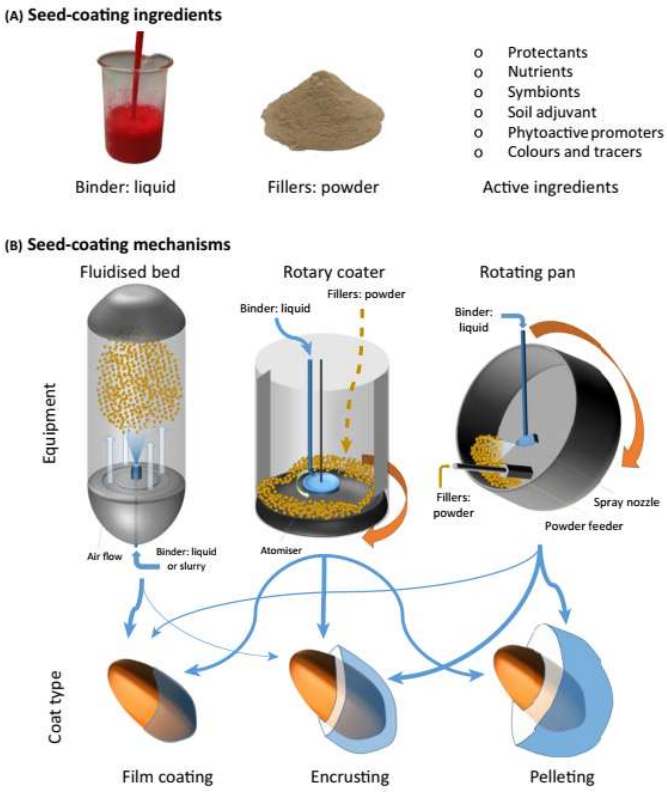

Figure 1: Seed coating, Illustration from Pedrini et al. 2017

Why is Seed Priming Preferred?

Seed priming is a pre-sowing treatment where seeds are soaked in water or osmotic solutions to enhance germination and early growth. It is widely used in laboratories due to its simplicity, versatility, and cost-effectiveness.

Reasons for Laboratory Use:

- **Simplicity:** Easy procedures, no specialized equipment required.
- **Versatility:** Applicable to many seed types and species.
- **Cost-Effectiveness:** Uses inexpensive, readily available materials (water, osmotic solutions, simple chemical additives).
- **Controlled Conditions:** Laboratory environments allow regulation of temperature, humidity, and light for optimal results.
- **Scalability:** Can be adjusted for small or large seed batches depending on experimental needs.

2. Biochar loading:

- Each 30 mL portion of biochar (loaded with biostimulant or non-loaded) is treated additionally with a solution consisting of 3 mL microbial suspension and 3 mL PBS, corresponding to a total liquid content of 20% (v/v).
- The mixture must be stirred thoroughly and dried for 16–20 h at 20-30 °C.
- The dried biochar can be used immediately or must be stored at 4 °C until use.
- The biochar is placed into the seed furrow, but direct contact with the seed should be avoided by applying a layer of soil between biochar and seeds (see Figure 2).

Why use Biochar as a carrier?

Biochar has a porous structure that easily adsorbs liquids. Therefore, Biochar provides an effective carrier medium for all kinds of liquid soil treatments such as fertilisers, biostimulants and microbial suspensions.

Multiple benefits for the soil:

- ❖ Improves soil fertility
- ❖ Increases the retention capacity of soils
- ❖ Loosens heavy and compacted soils
- ❖ Stores up to 5x its own weight in water and the nutrients dissolved in it
- ❖ Provides an optimal habitat for microorganisms, thereby increasing biological activity in the soil
- ❖ Reduction of soil leaching
- ❖ Active contribution to climate protection

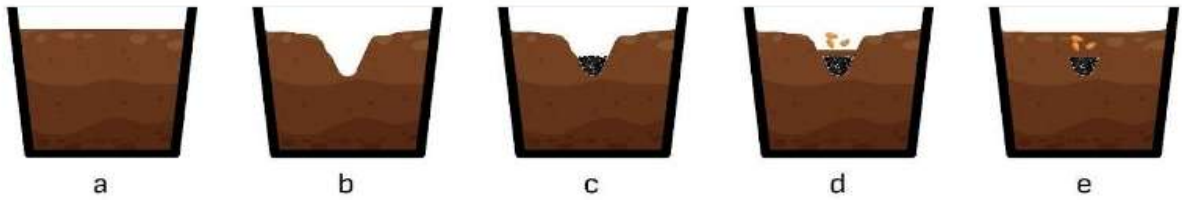

Figure 2: Pot-filling scheme: (a) Pots (7 × 7 × 8 cm; 0.35 L) were filled with soil. A central hole was made using a pricking tool (b), 1 mL of biochar was added and lightly covered with soil (c). Three untreated barley seeds were then placed in the same hole and covered with additional soil (d + e).