Beyond the Seed: How Coatings Boost Crop Yield

Babanjeet[1]*, Monisha T[1], Navdeep Singh[1] and Jaswant Prajapati[1]

[1]*Research Scholar, Department of Vegetable Science, Punjab Agricultural University, Ludhiana*

Corresponding Author
Babanjeet
Email: babanjeet-vs@pau.edu

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ABSTRACT

Seed coating methods entail the application of several chemicals to seeds to augment their performance, safeguard them against pests and diseases, and increase their handling characteristics. These ingredients, referred to as seed treatments or seed dressings, may comprise active chemicals such as bio-stimulants, fertilisers, and protection agents, together with liquids and solid particles. The selection of coating techniques and materials is contingent upon the intended results and the particular requirements of the crop. Prevalent coating methodologies encompass dry powder coating, seed dressing, film coating, encrusting, pelleting, and agglomeration. Although seed coating technologies have various advantages, including enhanced yield and seedling vigour, their implementation in developing nations is frequently obstructed by financial limitations and restricted access to information and resources. To encourage the broader adoption of seed coating technologies in these areas, it is imperative to create cost-effective and accessible solutions that are customised to local conditions and agricultural methods.

INTRODUCTION

Farmers constantly demand superior varieties of seeds, that may contribute to a potential rise of 40% in yield and production. Seed treatments denote the substance that contains chemical compounds, whereas seed dressings represent the minimum covering that occurs following the administration of seed treatments to seeds.

Seed coatings are most successful when they are purpose-driven and tailored to specific crops, ensuring excellent stand establishment and improved yields under varying climatic circumstances.

Components in Seed Treatment

A diverse array of materials is utilised in seed conditioning and coatings. The materials were classified based on their chemical makeup and source into synthetic chemicals, organic substances, biological agents and minerals extracted from the soil. Seed treatments and coatings are additionally classified by their function, comprising active components, liquids, or solid particles.

Active Components

The role of active chemicals is to protect and enhance the efficacy of seeds and seedlings in terms of sprouting, improvement, and evolution. The active ingredient's mechanism of action dictates its role in safety and/or enhancement. The active components include bio-stimulants, fertilizers, protective substances against stresses, and inoculants. Elicitors are being examined as effective agents for controlling pests and drought stress reduction (Afzal *et al.,* 2020).

Liquids

Around 60% of the ingredients in the coating are colourants, which are often used to show that the seeds have been handled. They are added at the end of the seed pelleting process. Additionally, colourants provide a visual assessment of how well they are applied and how they look. Seed coating agents function as binders during seed treatment. Adhesives make sure that the layer stays strong during and after the drying process. During handling and planting, they stop cracking and the spread of dust. Adjuvants are employed because majority of the active components in chemical seed treatments exhibit restricted water solubility, necessitating agents to formulate wet seed treatments. Surfactants are the active ingredients, and a method for enclosing seeds that uses them has been shown to help them grow.

Solid Particulates

When seeds are encapsulated, solid particles are used as the main material. These particles harden into a solid layer when they dry. Sticky things can also be made of solid bits. Granular particles are employed in a very fine powder form and go through hydrolysis upon the application of water throughout the coating process. A seed-coating combination can be made by combining fillers, which are fine powders, with solid particle binders. The effectiveness of seed pelleting depends on how well the filler components are chosen and optimised so that they don't affect seed sprouting. Fillers are cost-effective, harmless, readily accessible which produce consistent coating that do not prevent the emergence of radicles.

Seed Coating Equipment and Methods

The amount of active chemicals, solutions, and solid substances used per seed block is what mostly determines the choice of seed coating technologies. Dry coating, pelleting pans, and rotary pans are the three main types of coating tools used today. The coating equipment can be used by itself or with other equipment. It is linked to a number of methods, including seed washing, dry powder, film coating, pelleting, and encrusting. The main goal of both coating equipment and methods is to get the best level of uniformity and adhesion.

Dry Powder Coating

The process of combining seeds with a dry powder is known as "dry powder administration." Dry powders, or dusts, are utilised for microbial infections, succeeded by soaking or water loss, then seeds show

increased shelf-life after administration. It could be used to make sure that no damage is done to the seeds during coating when marked products are used to get rid of pests. Talc and graphite make up most of the dry bits.

Seed Dressing

Seed coating is the most common way to put small amounts of active ingredients on seeds. The formulation dose ranges between 0.05% and 1.0% with volume. To control the higher absorption of chemicals, especially pesticides, finishing granules are added right after the liquid is applied to soak up any extra liquid (Sohail *et al.*, 2022). The rotating coater is the machine that is used most often.

Film coating

Film coating is the process of putting a thin, even layer on top of the seed. The main tool used for covering seed films is the rotary coater. Polymers, like flowing materials, are made to spread the substance out before it is put on the seeds. The film layer recovered 90% of its original size with little change during the process. Film coating is a method that is becoming more common and useful for applying seeds (Javed *et al.*, 2022). The effectiveness of coated seeds is judged by how many grow and how much dust they prevent. This method also makes it easier for seeds to move around while they are being treated, processed, and planted. Between 2% and 5% of the volume of the seed is added to the weight of covered seeds.

Encrusting

With encrusting, which uses both liquids and solids to cover a seed fully and keep its shape, a coating technology is created. Put inside a shell, seeds are sometimes called pellets or covered seeds. Coating pan and rotating coater are the main encrusting methods for making capsuled seed. Because there is a lot of water in the coating, the newly cased seed needs to be dried out to get back to its original level of wetness before it can be stored. Capsuled seeds have been shown to help seedlings grow faster.

Pelleting and Agglomeration

The coating process is expanded through seed pelleting, which creates a larger buildup that hides the seed's original size. Fillers and dry powders are mixed together to make a binding mixture that only needs water as a liquid during the application process. The amount of weight that goes up after pelleting and drying ranges from 500 to over 5000. To ensure that coated seed sprouts unhindered by its granular matrix, the selection of liquids and fillers is essential (Taylor *et al.*, 2022). Pelleting necessitates the greatest investment of labor and knowledge compared with alternative processes, owing with substantial administration of active substances.

CONCLUSION

Seed coating technologies have many benefits, such as protecting seeds from pests and diseases while they are being planted and making them easier to flow for precise planting. Even though there is a lot of knowledge about natural or synthetic active ingredients, coating techniques, and polymers, the seed industry in many developing countries is not using this technology. Usually, treatments that are good for the budget are chosen. So, the success of seed coating technology depends on picking covering chemicals that are both cheap and easy to get. For implementation in poor countries, materials and methods must be simple and not cost a lot of money.

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