http://journal.unoeste.br/index.php/ca/indexD
DOI: DOI: 10.5747/ca.2023.v19.h516
ISSN on-line 1809-8215

Colloquium Agrariae

Submetido: 27/01/2022 Revisado: 01/02/2023 Aceito: 10/02/2023

SEED TREATMENT: IMPORTANCE OF PRODUCTS AND EQUIPMENT

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Abstract

Seed treatment is extremely important and beneficial for all crops, which aims to eliminate and control fungi, insects and other pests that attack seeds, seedlings and plants. For this, it is necessary to use new technologies and agricultural equipment that help in the treatment of these seeds, making the producer more profitable. This literary review aims to describe different types of seed treatments and agricultural equipment that can help in this process. This study took place between October and November 2022 and used different works as a basis to develop this review, in which it can be seen that the demand for seed treatment in Brazil has increased in relation to the use of fungicides and application technologies and equipment. , where it can be concluded that seed treatment is constantly evolving, both with regard to seed treatment equipment and the chemical and biological products used.

Keywords: quality; cultivars; productivity; organic agriculture.

TRATAMENTO DE SEMENTES: IMPORTÂNCIA DOS PRODUTOS E EQUIPAMENTOS

Resumo

O tratamento de sementes é de extrema importância e benéfica para todas as culturas, na qual tem por objetivo a eliminação, controle de fungos, insetos e outras pragas que atacam sementes, mudas e plantas. Para isso se faz necessário o uso de novas tecnologias e equipamentos agrícolas que auxiliam no tratamento dessas sementes, fazendo com que haja uma maior rentabilidade ao produtor. Está revisão literária têm como objetivo descrever diferentes tipos de tratamentos de sementes e equipamentos agrícolas que podem auxiliar nesse processo. Este estudo ocorreu entre os meses de outubro e novembro de 2022 e usou como base diferentes trabalhos para desenvolver está revisão, na qual pode perceber que a demanda por tratamento de sementes no Brasil tem aumentado em relação ao uso de fungicidas e tecnologias e equipamentos de aplicação, onde pode-se concluir que o tratamento de sementes está em constante evolução, tanto no que diz respeito aos equipamentos de tratamento de sementes quanto aos produtos químicos e biológicos utilizados.

Palavras-chave: qualidade; cultivares; produtividade; agricultura orgânica.

1. Introduction

Seed treatment can be understood as any operation involving seeds, whether through handling, incorporation of chemical or biological products on their surface or interior, or even the use of physical agents, aiming at improving and guaranteeing their performance in growth conditions (ZINSMEISTER *et al*., 2020).

Seed is the most important investment that farmers make in a crop, as high-quality seed can result in an increase in yield (AFZAL *et al*., 2016). In this review, seed treatments are vital to protect this essential input present in our crops. There are several technologies applied to seeds such as inoculants, herbicide pesticides, micronutrients, growth regulators, coatings, dyes that can also be considered seed treatment, which is exclusively intended for planting before sowing so as not to lose effectiveness and never for human health, or animal feed (PICCININ *et al*., 2018).

Seed treatment prevents pests from entering crops and is of great importance in the development of vigorous and healthy plants. This practice protects this input from the initial contact with the soil until the beginning of plant growth. Protection occurs before, during and after germination (MARTINS *et al*., 2016; RAGA *et al*., 2020; SILOTO *et al*., 2020). Thus, seeds threatened by diseases, pests or even climate interference may have more uniform germination and better rooting. Finally, all of this translates into productivity, final quality that is the result that the producer wants to achieve (SCHONS *et al*., 2018).

With regard to innovation in seed treatment, especially industrial seed treatment, companies have been working to create new technologies that are more productive and at the same time more sustainable, especially designed to meet the needs of farmers (PEDRINI *et al*., 2017). Both in seed treatment and in combating pest control (insects, nematodes, weeds, diseases, among others), making products and pesticides work together to assist in integrated pest management practices, helping to increase production and crop yield (PEREIRA *et al*., 2019).

As for the forms of seed treatment, there are two forms of seed treatment, namely: on-farm, carried out by the producer shortly before sowing, or industrial seed treatment (TSI), where the latter becomes more efficient, as it gives to the seed a uniform dosage of the product to be used, carried out by a trained professional, which consequently allows for a more uniform, healthy and productive crop (PEREIRA *et al*., 2019).

Regarding the use of agricultural equipment for coating seeds, the availability of appropriate equipment for this purpose is mainly determined by the dosage of actives, liquids and solid components applied per seed unit. There are three main types of seed coating equipment currently

used: dry coating, rotary pan and granulating pan (HALMER, 2000). The overall objective of all coating equipment and methods is to achieve good uniformity and adhesion in application and the processes must not cause mechanical damage to the seeds during coating. Given the above, this literature review aims to show the types of seed treatments and the different agricultural equipment used to carry out this type of treatment.

2. Methodology

The study of this bibliographical review was carried out between the months of October and November of this year, in which l it includes the consultation of scientific publications that allow describing the processes, products used and equipment in seed treatment. According to (PEREIRA *et al*., 2019), when preparing a literature review, the results of some discovery, experience carried out, describing a case, describing some phenomenon that have occurred are being reported.

3. Result and Discussion

It is essential to obtain seeds with qualities and techniques that need to be adopted in seed treatment. Seed treatment is a total consolidation technique that benefits producers, protecting seeds and seedlings in the initial phase of implantation and development, using products such as fungicides, insecticides, inoculants, and nematicides, polymers and micronutrients (OLIVEIRA *et al*., 2016).

In addition, seed treatment has been increasing, in Brazil, in 2020 this increase reached a figure of US$ 654 million, considering insecticides, fungicides and nematicides. Fungicides contributed USD 85 million, representing 13% of this total market, with stability forecast for the next 5 years. In the specific case of soybean, this value was US$ 39 million (10% of the seed treatment market in this crop), also with stability forecast for the next five years, this increase is due to the use of different treatments and technologies used, among them are (EMBRAPA, 2021).

3.1 Treatment with fungicides

One of the routine practices of integrated crop management is the use of fungicides in seed treatment, which aims to improve seed emergence, plant vigor and protection against fungal pathogens transmitted by seeds and soil (LAMICHHANE *et al*., 2020). There are different methods of performing seed treatment and that dependent and independent of the culture there is a range of fungi in seeds and that if there is no treatment it can affect productivity (KINGE *et al*., 2019; CHUN *et al*., 2021).

Seed treatments are usually provided before sowing as seed dressing, seed coating or pelleting (PEDRINI *et al*., 2017). The most common method of seed treatment, seeds are treated

with dry or wet formulations of fungicides, pesticides and even seeds can be treated with natural bioformulants such as: Pseudomonas, Trichoderma and Rhizobia to improve their performance in the field. Seed coating is usually performed by industries for large batches of seeds and seed pelleting is practiced for crops with small seeds (AGRITECH, 2020).

Regarding the diversity of products, the most used by producers and recommended for seed treatment are two (Thiram and Captan), as they are fungicides with a protective mode of action, considered disinfectants that act in the control of pathogens located on the external surface of the seeds.

3.2 Thiram

Introduced on the market in 1931, thiram is a thiocarbamate fungicide with a broad-spectrum antibacterial property, its molecular formula is $C_6H_{12}N_2S_4$. In addition, thiram can also be used as a super accelerator for natural gums, synthetic gums and latex. In seed treatment with thiram, it acts as a protective fungicide on seeds, but it is also used in foliar spraying on grass, vegetables and fruits (ELIF; EDA, 2019).

Thiram is commonly used for control of apple black spot, tobacco and sugar beet root rot and yellow rust, rice blast, white leaf spot and rust, control of black ear disease of wheat, maize and sorghum, etc. (OSMAN *et al*., 2012). In fields and orchards, high doses of thiram are used as a repellent for birds, rabbits, rodents and deer (LIDIA *et al*., 2017). The detection rate of thiram residues in tobacco is high due to its wide use due to its high efficiency and low toxicity.

Thiram is being widely used in agriculture and this product can cause harm to the environment and animal bodies if not handled or stored properly in chemical factories and warehouses (MONIKA *et al*., 2017). Not to mention thiram also poses an explosion hazard; its dust can form explosive mixtures when mixed with air. The half-life of thiram in the soil is around 15 days and its degradation time is influenced by environmental factors such as pH and soil moisture (SHARMA *et al*., 2003).

3.3 Captan

Captan was the first contact fungicide to be used in seed treatment in the 1950s to protect seeds against a variety of fungal pathogens and inhibit fungal entry into plant tissue (KITTLESON, 1952). Around the same time, the effectiveness of methylmercury for the treatment of small grains was also recognized. However, due to environmental concerns, its use was discontinued in the early 1970s (BIRAH *et al*., 2014).

This class of fungicide is part of the heterocyclic nitrogenous group and is composed of CAPTANA, which has a mechanism of action of multisite contact activity, has a toxicological

classification classified as four (little toxic product), non-flammable, concentrated adjuvant, non-toxic mode of action. systemic, preventive, non-corrosive, a dangerous product in terms of the environment and widely used in the treatment of cotton, bean, corn and soybean seeds (AGROLINK, 2021).

3.4 Pelletizing

For the Brazilian Seed Technology Association (ABRATES), pelleted seeds are defined as more or more minor spherical units facilitating sowing, keeping the typical shape and size of treated seeds within a specific limit.

Generally speaking, we can say that pelletizing (Figure 1) is a process that consists of the incorporation of inert elements, such as cellulose powder, talc, non-ionic polymers, clays, and other products such as: mixing with an adhesive material such as calcium sulfate, starch, cellulose derivatives, polyvinyl polymers, among other products that can be used on the surface of seeds with the gradual addition of water, drying and addition of new layers until reaching the desired shape and size of the pellet (SANTOS, 2016).

Figure 1. Represents the pelleting of lettuce (*Lactuca sativa*), tobacco (*Nicotia tabacum*) and chicory (*Cichorium intybus*) seeds. Capão do Leão, 2022.

3.5 Films

Filming is a technology that allows, among other uses, the addition of agrochemicals to seeds without changing their size or shape. For example, polymer composite films have been widely used in the seed industry to enable the identification, differentiation, and traceability of high-value seeds due to different colors, and that improve crop stand provided by better fluidity of seeds in planting (PINHEIRO *et al*., 2018).

Films give a significant reduction in agrochemical losses provided by the improved distribution coverage and adhesion of active ingredients on the surface of fast-drying seeds, which reduces dust after the treatment process, providing better safety for operators, in addition to presenting a more emergency rapid and uniform seedlings (SENE *et al*., 2021).

Thus, the layers, in addition to being used as materials that help keep chemical products uniformly fixed to the seeds, also improve their germination performance, especially when exposed to unfavorable conditions that affect the germination process (MELO *et al*., 2015). Thus, filming technologies have been investigated to mitigate the impact of environmental stress on germination and seedling establishment (MELO *et al*., 2015).

3.6 Micronutrients

The proper functioning of each living cell is only possible through the availability of essential macro and microelements. A critical network of gene products controls complex processes for the absorption, binding, transport and repossession of a given element in plant cells (BAXTER, 2019). Murgia (2015), revealed that changes in the nutritional status of macro or microelements in plants (Figure 2) are associated with changes in a certain subset of elements.

Figure 2. Represents Liebig's law of minimum. Capão do Leão, 2022.

Micronutrients are being used more and more, including Cobalt, Molybdenum, Zinc, Copper and Manganese, which are the elements most often deficient in soil, negatively affecting cultivated species. In addition, these same nutrients are absorbed in small amounts by plants in relation to macronutrients (BUTKE; LEITE, 2020).

As for the levels of micronutrients present in the soil, these are insufficient to maintain plant demand, as there is a drastic reduction in the physiological activity of plants, directly impacting crop productivity at the beginning of the development of several crops (MANFRO, 2021).

In the specific case of soybeans, the use of micronutrients such as molybdenum (Mo), essential for the crop, and cobalt (Co), an essential chemical element for bacteria, are associated with the roots, acting in a beneficial way, fixing nitrogen atmosphere by means of fixative bacteria (MANFRO, 2021).

Molybdenum (Mo) is an essential microelement for higher plants and also a metallic component of the Mo cofactor biosynthesis (Moco) (HUANG *et al*., 2022; BAVARESCO *et al*.,

2022). Moco binds to enzymes that require Mo and optimizes their activities for the normal unctioning of plant growth and development processes. The Mo plays a significant role in N metabolism, which includes nitrate reduction, assimilation and fixation, regulating the activities and expression of NR and GS enzymes (MIN *et al*., 2020; LIU *et al*., 2017). Furthermore, previous studies have reported that Mo deficiencies are predominantly associated with poor N health, and plants show symptoms similar to N deficiencies, indicating that Mo plays a key role in N metabolism.

It is estimated that today in Brazil, more than 95% of planted soybean seeds are treated, with the practice of treating seeds with micronutrients linked to the most practical and efficient way of supplying them with nutrition being of paramount importance (MANFRO, 2021).

Because as soybean cultivation intensifies with the use of increasingly productive varieties and the application of chemical products on a larger scale, the soil tends to present deficiencies of these nutrients, in this case, the micronutrients that are required even in low amounts play a role an important role, determinant in production due to its role in fundamental biochemical processes for plant development (BUTKE; LEITE, 2020).

3.7 Inoculants

The agricultural production system in recent years was very dependent on chemical inputs, such as pesticides, herbicides and fertilizers to increase the yield of its crops, however the excessive use of these chemical products, affected the quality of the soil and causing the plants to grow deteriorate and thereby affect human health (ALORI, 2018). Given these factors, it was and is necessary to produce in a more sustainable way to minimize the harmful effects of these chemicals and promote plant growth, in addition to improving soil quality without disturbing the natural ecosystem (BABALOLA *et al*., 2012).

Therefore, the use of inoculants is nothing more than biological inputs that contain microorganisms with beneficial action for the development of plants and can act as: biofertilizers, bioherbicides, biopesticides and biocontrol agents (BABALOLA *et al*., 2012). They can be found mainly in liquid form, peat and bacteria that form nodules on plant roots to fix the nitrogen developed and produced according to established protocols (DOURADO NETO *et al*., 2018).

Formulations of beneficial microorganisms, which play an affirmative role in the soil biome in an ecologically correct way, are called microbial inoculants. Natural soil contains a variety of microorganisms important for agriculture that have a beneficial effect on soil and plants, providing nutrients and also protecting the plant from pests and diseases (CALVO *et al*., 2018).

Inoculation with microorganisms is of great importance for crops, especially for legumes, as biological nitrogen fixation (BNF) represents one of the pillars of sustainability in the production

system and results in great benefits for both the producer and the environment, by reducing or even eliminating the use of nitrogen fertilizers in the crop (VIANA, 2019).

Some so-called long-life inoculants can preserve the viability of bacterial cells after being applied to the seed, extending the window between inoculation and planting for up to 60 days (VIANA, 2019). This innovative technology enables early inoculation, and its application in IST has the primary objective of facilitating the sowing operation and delivering treated seeds to the producer without loss of efficiency or even antagonistic effects that generate bacterial mortality (OWEN *et al*., 2015).

Pre-inoculants have high concentrations of bacteria, contain twice as many microorganisms as conventional inoculants and are highly compatible with seed treatments, thus being an advantageous and efficient option offered to the producer (VIANA, 2019).

3.8 Equipment used in seed treatment

There are two application technology systems used in industrial seed treatment: Industrial seed treatment with continuous flow and industrial seed treatment by batch (LEVANDOSKI, 2017).

The first step is the seed flow (input), usually coming from a silo after processing. This seed flow can be carried out by different mechanisms like gravity conveyor screws, conveyors, rotating drums, and scales. Be an individual or combined mechanism (LEVANDOSKI, 2017).

The second step is the syrup flow, usually coming from a reservoir. There are several mechanisms for carrying out this syrup flow in the treatment process, like seed flow. Similarly, it must be measured and controlled so that there is a homogeneous treatment. Therefore, the first and second stages are processes that can occur simultaneously or intermittently during seed treatment, which can occur at the same time in continuous seed treatment, or intermittently in batch treatment (LEVANDOSKI, 2017).

The third step, the primary application of the treatment inputs to the seeds, is one of the most critical parts of the process, as this is where the seeds will have the first contact with the products used for treatment. The physical properties of the product highly influence this step. Such as density and viscosity (LEVANDOSKI, 2017).

The fourth stage is the second application in the treatment. It distributes or distributes the product over the seeds so that it is homogenized by all of them (LEVANDOSKI, 2017).

Regarding pelleting, there is a machine model called the Spray System, this system is controlled by a Chinese hat or by a motor in which the seeds enter the equipment, applying the solution that is conducted by a snail system to the packaging. However, before being bagged, the drying powder and/or graphite are deposited (FRANCO *et al*., 2018).

4. Final Considerations

According to what we can see, seed treatment is constantly evolving, both with regard to equipment and the chemical and mainly biological products used, allowing us to maintain the physiological quality of the seeds, especially during their initial start-up.

Given this scenario, it is expected that in the future there will be even more information, mainly focusing on the combination between biological and chemical products and products that cause less damage to the environment, giving more emphasis and importance to the topic addressed.

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