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Polymer coating of vegetable seeds

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The seed coating process involves all aspects of sticking materials onto the surface of seeds. The term 'coated seed' has been applied to a seeds, which was either pelleted covered with an adhesive film. Such procedures are adequate for about 90 per cent of small seed species. The costs and benefits of the coating procedure should be evaluated prier to selecting the seeds for the operation. Some seeds of high aggregated value like hybrid flower seeds, usually obtained in small amounts should never be coated because the risks involved with the process may far exceed the benefits (Taylor and Harman, 1990). On the other hand for many species of seeds, the coating process is worthy to be applied with consequent improvement on the seeds quality and maintenance of properties after storage.

Seed coating is a process designed to create a nutritious environment in the immediate vicinity of the germinating seed. This provides a "boost" for the seedling in its critical early stages of development. Coated seed was first manufactured in Canada in 1977. It was readily accepted by most users and now has a definite role to play in Canadian agriculture.

Coated seed benefits the plant in its critical seedling stage thus ensuring early vigor and maximum establishment. There is some carryover effect from this increased seedling vigor but once the fertilizer coat has been assimilated by the plant, it cannot be of any further direct benefit in its future development. The present economic, nutrient and chemical benefits, which are available to coated seed users today, make it a very worthwhile product.

The conventional treatment of seeds uses chemical products to protect the seeds and seedlings against diseases, insects and other plagues. The treatment is well accepted today as an agronomic practice for the seeds of most species and it is routine at the seed processing unit. However, the conventional seed treatment is limited as for the diversity of products to be applied and it also presents risks for the operator's health due to dust and handling poisonous products. Therefore, a new process, the seed wetting was developed. Since 90's, this technology is in the top of the sowing industry, due to the relative concerns with safety for workers and environment protection, as well as the sowing the precision, since the process serves to improve the plantability of the seeds.

In recent years, film–coating methods have been developed to overcome these problems. In film coating, the chemicals are applied in a polymer that is sprayed on the seeds as they fall though a specialized machine. The polymer is rapidly dried, so that the seeds emerge with a complete, dry polymeric coating.

Some novel applications have also been developed using the film coating method. For example, artificial polymers have been developed that exhibit temperature-sensitive permeability to water. These polymers are permeable to water at warm temperatures, but not at cool temperatures.

Seeds coated with these polymers will not imbibe water – that is, absorb water and swell–if the temperature is below the set point of the polymer, potentially protecting the seed from chilling injury or germinating in an unfavorable environment.

The coatings are also being used to delay germination after planting, such as for timing the emergence of parental lines at different times to ensure synchronous flowering for hybrid seed production. A starch–based biopolymer is also being used in film coating to slow water uptake and alleviate chilling injury.

Seed coating consists of the deposition of a fine and uniform layer of polymeric and other products on the surface of the seeds. In general, the process represents a one third of the covering and the seed two thirds (the coated seed can reach upto 50 material parts and one seed part). It can be used jointly with the chemical and biological treatment, a protecting material and with minimum impact on the environment. This makes this technology highly efficient in the protection of the sees, when combining fungicides with insecticides (active ingredients) and with a layer or pellicle made of polymeric liquid (sticker).

As for the application methodology, the seeds are mixed with a sticker, so that each seed is hidden. The sticker should be soluble in water and the polymeric usually used are organic, starches, natural resins, sugars, glues that are dispersed in water. The solids are added right after. When the seed gets in touch with the soil, the covering should not offer resistance to the radical and to the structure that it will form the aerial part of the plant, allowing the passage of water and oxygen so that the embryo begins to develop naturally.

This advance technology allows combining hormones, microelements, fungicides, insecticide and composed buffer, modifying the permeability to gasses and moisture of the seeds. It must allow an easy degradation of the pellet and be biodegradable nature. It must allow the seeds to germinate and emerge under conditions below ideal.

The development of technologies to improve the seed treating machines as well as specific equipments for seed coating, allows a fast and necessary application of polymer film. Also the development of the chemical industry of polymer application to the seeds and its compatibility with the active ingredients traditionally applied in the treatment. The polymers are compound formed by many repeated units which enhances the appearances of the seeds and contributes in the commercialization process.

Main advantages of seed coating :

- Improves the efficiency of the production products, allowing on excellent covering and adhesion of the active ingredients on the seed.
- Improve the sowing process.
- Improves the safety in the use when creating a barrier between the skin of the operator and the product, eliminating the dangers related with the treatment, packing and sowing of the seed.
- Reduces the dust of the products.
- Provides a way of carrying fungicides, pesticides, biological products and micronutrients.
- Bitter retention of the treatment strong. Adherence to the surface of the seed, leaving fewer pesticides residues.
- Protects the seed against mechanical damages.
- Helps to protect seeds stored under conditions of high moisture.
- Improves the appearance of the seed, with attractive colours that can identify the seed, the producer or the treatment applied.

Benefit from using coated seed :

Coated seed has many benefits and advantages to offer forage, oilseed and others. These include the most effective method of pre–inoculation available, significant benefits to the seedling from the starter fertilizer package contained in the coat and the fact that it is an economical, effective method of seed treatment. Coating is considered the simplest, safest and most effective way to treat any seed with virtually any seed treatment.

Pre–Inoculation :

Pre-inoculation is the addition of nodule bacteria (*Rhizobia*) to the seed, weeks or even months in advance of sowing. It ensures that the bacteria are in close proximity to the roots of the germinating seedling and thus, in a position to cause fast, effective nodulation.

The need for legume inoculation is now widely recognized, particularly in the case of trefoils, as there are few native populations of the rhizobium (loti) necessary to induce nodulation in this species present in North American soils.

Nutrient benefits :

Seed coating creates a nutritious environment around the establishing seedling and increases vigor during its critical early development. The main nutrient included in our seed coatings is phosphorus. Even on soils with sufficiently high phosphorus levels to sustain normal growth, localized placement is very beneficial. It is desirable from the standpoint of accessibility to the establishing seedling and in order to reduce fixation. Phosphorus does not move in the soil, therefore, the nearer it can be placed to the seed, the more effectively it can be utilized by the seedling.

Seed treatments :

Research data available from trials using various seed treatments indicate that they may have a detrimental affect on the viability of some strains of rhizobium. Research with coated seed products containing seed treatments has shown good compatibility between the seed treatments and rhizobium when the rhizobium are encased by the layering effect of the coating materials.

Protection from stress conditions :

The coating materials, as well as the physical barrier created by the coat itself, protect the rhizobium and seed from low pH conditions. Calcium Carbonate is very effective in buffering soil pH in the micro-environment around the seed. The pH range of coated seed (6.5 to 7) is optimum for nutrient uptake and while desiccation can quickly reduce the rhizobium populations, the coat offers the bacteria protection from the effects of drying winds and sun. This is especially beneficial when forage legumes are sown by air or broadcast.

Protection from animals, birds and fertilizers :

Most rodents and birds do not recognize coated seed as food. The increased size of the seed is one–reason birds do not take it and the coating materials, especially the dyes and phosphate used in turfgrasses, are not at all palatable to either rodents or birds. Some fertilizers, e.g. superphosphate and sulphate of ammonia, can't be mixed with uncoated seed. The coating layer protects both the seed and the rhizobium from the harmful effects of these fertilizers.

Ballistic properties :

Coated grass seed is approximately twice the weight of bare seed. Aerial sown grasses penetrate ground cover more effectively than bare seed and thus make better contact with the seedbed. Some seeds, e.g. meadow foxtail and bromegrass, are difficult to sow due to their very light weight. Coating can increase the weight of these species, by as much as three times and this, combined with the increased size of the seed, facilitates sowing.

Polymer coating on germination, vigour and yield potential :

Seed coated with polymer film coating, fungicides and micronutrients registered good germination energy and germination per cent in lucern crop. Seed germination and seedling growth were best and fungal infection was lowest with ecapsulation or coating with gypsum + bentonite or the polymer scpiret 6182 combined with fungicides carboxin + thiram.

Broccoli seeds were coated in a sprouted bed, by an aqueous suspension of hydroxyl–ethyl–cellulose. Effect of the operating variables: sprouting air temperature, atomizing air pressure and coating suspension flow rate over the dependent variables: seeds germination, seeds accelerated aging and the speed of seeds germination in soil, were investigated in a factorial scheme trial. The maximum processing time was 120 min. A totally randomized experiment evaluate and composed seed germination and vigour of the coated and non-coated seeds. The surface of coated seeds presented satisfactory distribution and spreading of the polymer film, uniform and individual coating and homogenous aspects (Almeida *et al*., 2005).

Polymer coating for improving the health of the seeds :

Seeds film coated with fipronil and imidacloprid showed effective control of thrips on the seed bed for 12 weeks and 13 weeks after transplanting. Film coating the seed with fripronil, diflubenzuron, imidacloprit and teflubenzuron gave acceptable control of the larvae of the onion fly, whereas coating with benfuracarb and methiocarb was only moderately effective. The use of fipronil and imidacloprid film coated seeds resulted in sufficient protection against the leek moth at low population desities. Oospore germination was unaffected by the film coating with *Phythium oliganidum* oospores on to sugarbeet. The coating gaves significant control of damping off. The film coating with *Cercospora militans* onto infected sunflower seeds decreased the germination of conidia.

Effect of seed coating material in the efficacy of microbial antagonists for the control of root rot fungi on okra and sunflower :

The biological potential of different microbial antagonists *viz.*, *Bacillus thuringiensis*, *Rhizobium meliloti*, *Aspergillums niger* and *Trichoderma harzianum* was examined by coating the seeds with gum arabic, glucose, sugar and mallases in the suppression of root rot fungi *viz.*, *Macrophomina phaseolina*, *Rhizoctonia solani* and *Fusarium* spp., on okra and sunflower plants. All biocontrol agents enhanced the germination and growth of plants as compared to control. Shoot length, shoot weight, root length and root weight were significantly increased in okra and sunflower. Gum arabic was found more effective in reducing infection by root rot fungi *viz.*, *M. phaseolina, R. solani* and *Fusarium* spp. of the different microbial antagonists used, *T. harzianum* was found more effective followed by *B. thuringiensis, R. meliloti* and *A. niger* is the control of root rot fungi (Dawar *et al*., 2008).

Effect of fungicide and polymer film coating on storability of onion seeds :

The seeds were film coated with polymer clear (Polycote) of different concentration *viz.*, 6 ml, 9 ml and 12 ml per kg of seeds with and without fungicide (Thiram @ 2kg/kg of seeds) and stored in polythene bag and aluminium pouch containers. Among the treatments, seed coating with polymer @ 12 ml + thiram @ 2 g/kg of seeds recorded higher germination, vigour index, dry weight of seedlings and lower seed infection and electrical conductivity as compared to control. The seed stored in aluminium pouch recorded higher seed quality parameters as compared to polythene bag throughout the storage period (Basavaraj *et al*., 2008). Similar work related to polymer coating was aslo done by Shakil *et al.* (2007) on soybean; Manjunath *et al*. (2008); on chilli; Giang and Gowda (2007) on hybrid rice;Vanangamudi *et al*. (2003); Vijaykumar (2007) and struve and Hopper (1996) on cotton and Taylor *et al*. (2001) on onion.

Disadvantage of polymer coating :

- Higher cost for the coating process.
- The need of specific products.
- The need of machines with higher precision in the dosage of the product.

Main precautions :

- Covering not uniform;
- Performance of the product;
- Agglomeration of the product;
- Unacceptable appearance of the seed.

Still, a good seed recovering depends on the characteristics of the tegument of the seeds, of the levels and characteristics of the active ingredients, of the formulation type and of the appropriate necessary equipment.

Seed coating is a new technology that it is consolidating for great cultures due to advantages to the farmers. Among others, it allows to apply an appropriate and precise protection to the seed against diseases and insects; it improves the sowing process, allowing sowing of precision and establishment of an appropriate stand; it uniformizes the format of the seeds; it allows the adherence of the products necessary for the germination, as the absorption of water and gases, as wall as of the hormones that help in the germination and emergence; it adds micronutrients and it improves the operation conditions at seed processing unit.

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