



Seed treatment: Basis of profit maximization and sustainable agriculture

Hiralal Jana

Department of Agricultural Extension, College of Agriculture (B.C.K.V.), Agricultural Farm, BURDWAN (W.B.) INDIA (Email : janahiralal@yahoo.in)

The concept of seed treatment is the use and application of biological and chemical agents that control or contain primary soil and seed borne infestation of insects and diseases which pose devastating consequences to crop production and improving crop safety leading to good establishment of healthy and vigorous plants resulting better yields. Seed treatment refers to the application of fungicides, insecticides, or a combination of both, to seeds so as to disinfect and disinfect them from seed borne or soil borne pathogenic organisms and storage insects. Many diseases can be controlled by a simple chemical seed treatment. Plant disease organisms survive from season to season through spores carried on or in seeds. Some chemical seed treatments provide a protective zone around the seed through which soil-borne organisms cannot penetrate. The young seedling is protected from attack until it is capable of outgrowing attacks from soil-borne pathogens. Some plant disease organisms are carried inside the seed. As the seed germinates, the fungus grows along with the developing seedling, eventually causing disease symptoms in the mature plant. These internal infections can only be controlled by systemic seed treatments. There are many fungicides recommended for different fungi that attack seedlings. No one seed treatment will work to control this diverse group of pathogens. A material that is

highly effective in controlling a disease in small grains may not be effective on vegetable seed. These seed treatment chemicals vary considerably in their toxicity to humans and animals.

Present scenario : Presently, 70 per cent requirement of seed is met from the farmer's own stock which goes for sowing without seed treatment. Even if seed is sourced from the private or public sector agencies, except hybrid seeds, large percentage of such seed is untreated. The estimates reveal that on an average, 80 per cent of the seed sown in the country is untreated, as against the 100 per cent seed treatment practice in developed countries. Seed treatment not only protects the seeds from seed and soil borne diseases but also gives protection to the emerged seedlings from sucking insect pests affecting crop emergence and its early growth. However, many farmers in the country are neither familiar with the practice nor follow it.

Benefits of seed treatment :

- Improves seed germination
- Ensures uniform seedling emergence.
- Protect seeds or seedlings from early season insect-pests and diseases.
- Use of plant growth hormones may enhance crop performance during the growing season.

Evolution of seed treatments

Duration	Progress
Approx. 2000 B.C. to 100 A.D.	First soaking techniques: use of sap of onion
Middle Ages	Soaking in chlorine salts and manure
1600's	Soaking in salt water
Mid-1700's	Introduction of copper salts
1740	Introduction of arsenic
1765	Soaking in hot water
1808	Ban of arsenic
1915	Introduction of organo-mercurics
1960's	Introduction of first systemic fungicide
1970's	First systemic fungicide against air-borne pathogens
1982	Ban of organo-mercurics
1990's	Introduction of new modern fungicides and insecticides

- Rhizobium inoculation enhances the nitrogen fixing capacity of legume crops and their productivity.
- Improves plant population and thus higher productivity
- Treatments encourage healthy root system.
- Seed treatments have less risk of impact on non-target organisms and drift.
- Safe and economical in use and reduce personal and environmental hazards.
- It reduces application efforts and save time.
- Provides protection from storage insects.
- Controls soil insects.
- It prevents the spread of pests and diseases
- It enhances growth of crop.
- Seed treatment involves a more safe and judicious use of agrochemicals.
- Seed treatment is eco-friendly in nature.
- Seed treatment gives 6 to 8 weeks protection and also helps in the reduction of sprays.
- Lower seedling mortality.

Organic seed treatment :

Preventing disease in the field : Organic seed disease prevention starts with health promoting cultural practices in ecologically managed farms that prevent disease and pests in the first place, that include- crop rotation, appropriate planting dates, soil temperature and moisture, selecting disease-resistant varieties and cleaning and processing methods that control disease.

Seed surface treatments : Surface seed treatments reduce disease-causing fungi and bacteria found on the seed. Biological seed treatments control seed pests by parasitizing the pest organisms, competing for food on the root system, or producing toxic compounds that inhibit pathogen growth. Control of surface pathogens include beneficial microbes

in compost teas, herbal sprays, washes or oils, hot water, heat and disinfectants. Disease-suppressive compost has complex microbial communities that compete with and control pathogens. It is typically used to coat the leaf surface with beneficial microbes or as a soil drench. To produce suppressive compost, we suggest to pre-mix the raw ingredients, manage at lower temperatures on fertile soil, minimize turning and inoculate with earthworms to increase beneficial microbes. Vermicompost (earthworm castings) has been found to have significant disease-suppression.

Seed treatment and integrated pest management (IPM) :

The practice of seed treatment is IPM compatible. The use of seed treatment is consistent with the concept of IPM. The farmer must strive for the best pest management method that is safe, environmentally sound, and scientifically proven. Without the use of seed treatment, farmers would have great difficulty to control certain seed-borne and early season seedling diseases and insects and would have to resort to more expensive and less environmentally acceptable methods. According to FAO “IPM means a pest management system that, in the context of the associated environment and the population dynamics of the pest species, utilizes all suitable techniques and methods in as compatible a manner as possible and maintains the pest populations at levels below those causing economically unacceptable damage or loss.” Seed treatment can be used as a sound basis for a successful IPM programme.

Types of seed treatment :

Seed disinfection : Seed disinfection refers to the eradication of fungal spores that have become established within the seed coat, or in more deep-seated tissues. For effective control, the fungicidal treatment must, actually

Diseases controlled by seed treatment		
Disease	Pathogen involved	Hosts
Loose smut	<i>Ustilago nuda/ U. avenae</i>	Wheat, barley, oats
Covered smut	<i>Ustilago hordei</i>	Barley, oats
Dwarf bunt	<i>Tilletia controversa</i>	Wheat
Common bunt	<i>Tilletia laevis/ T. tritici</i>	Wheat
Barley stripe	<i>Pyrenophora graminea</i>	Barley
Seed decay	<i>Pythium spp.</i>	Wheat, barley, oats
Dryland root rot	<i>Fusarium culmorum/F. graminearum</i>	Wheat, barley
Dry seed decay	<i>Penicillium spp</i>	Wheat, barley, oats
Bare patch	<i>Rhizoctonia solani AG8</i>	Wheat, barley
Browning root rot	<i>Pythium spp.</i>	Wheat, barley, oats
Common root rot	<i>Cochliobolus sativus</i>	Wheat, barley
Take-all	<i>Gaeumannomyces graminis</i>	Wheat, barley, oats

penetrate the seed in order to kill the fungus that is present. *Seed disinfection* : Seed disinfection refers to the destruction of surface-borne organisms that have contaminated the seed surface but not infected the seed surface. Chemical dips, soaks, fungicides applied as dust, slurry or liquid have been found successful.

Seed protection : The purpose of seed protection is to protect the seed and young seedling from organisms in the soil which might otherwise cause decay of the seed before germination.

Conditions under which seed must be treated :

Injured seeds : Any break in the seed coat of a seed affords an excellent opportunity for fungi to enter the seed and either kill it, or awaken the seedling that will be produced from it. Seeds suffer mechanical injury during combining and threshing operations, or from being dropped from excessive heights. They may also be injured by weather or improper storage.

Diseased seed : Seed may be infected by disease organisms even at the time of harvest, or may become infected during processing, if processed on contaminated machinery or if stored in contaminated containers or warehouses.

Undesirable soil conditions : Seeds are sometimes planted under unfavourable soil conditions such as cold and damp soils, or extremely dry soils. Such unfavourable soil conditions may be favourable to the growth and development of certain fungi spores enabling them to attack and damage the seeds.

Disease-free seed : Seeds are invariably infected, by disease organisms ranging from no economic consequence

to severe economic consequences. Seed treatment provides a good insurance against diseases, soil-borne organisms and thus affords protection to weak seeds enabling them to germinate and produce seedlings.

How seed treatments are applied : Seed treatment is a term that describes both products and processes. Processes range from basic dressing to coating and pelleting. In all cases, the basis of good application techniques is to deliver the product to the seed at the correct dose and as uniformly as possible from seed to seed.

Seed dressing : The most common method of seed treatment. The seed is either dressed with a dry formulation or wet treated with a slurry or liquid formulation. Dressings are applied both on-farm or in specialised seed treatment facilities.

Seed coating : A special binder is used with a formulation to enhance adherence to the seed and begin to impact seed size and shape. Coatings require advanced treatment application technology.

Seed pelleting : It is the most sophisticated seed treatment technology, resulting in changing the physical shape of a seed to enhance plantability and handling. Pelleting requires specialised application machinery and techniques and is the most expensive of the applications. Depending on the type of desired treatment, various machines can be used. The more complex the treatment, the more cost is involved. Many modern treatment machines can deliver specific formulation and dosing by way of a direct injection process. The most sophisticated treatment machines can deliver the various formulations and additives as layers on the seed, which allows precise placement of the active

Seed treatment of major cereal crops			
Crop	Pest/disease	Seed treatments	Dose
Rice	Root rot disease	Trichoderma	5-10g/kg seed before transplanting
	Root knot and white tip nematode	Monocrotophos	Seed soaking in 0.02% for 6 hours
	Insect-pests	Chloropyriphos	3ml/kg seed
Wheat	Loose smut/ flag smut/ covered smut/bunt	Carboxin/Vitavax75% W.P.	2.5g/kg seed
		Tebuconazole (Raxil 2 DS)	1.0g/kg seed
		Carbendazim (Bavistin 50 WP)	2.5g/kg seed
	Termite	Trichoderma viride1.15% W.P.	4g/kg of seed
		Chloropyriphos	4ml/kg of seed
Maize	Soil and seed borne diseases	Endosulfan	7ml/kg seed
		Captan	3g/kg seed
		Thiram	3g/kg seed
		Vitavax	2g/kg seed
	Carbandazim	2g/kg seed	
Insects (stem fly)	Imidacloprid 200 SL	1ml /kg of seed	

ingredient.

Hot water treatment : Hot water treatment on seeds helps reduce the seedborne pathogens that cause diseases on plants. However, the specified temperature and time interval should be strictly followed in order to keep the effectiveness of the seeds to germinate. Use a good thermometer or better ask for assistance from qualified personnel from your local agricultural office.

Procedure :

- In a large pot put plenty of water.
- Heat the water following the required temperature.
- Place seeds in loose cotton bag and submerge it in water. Follow strictly the recommended temperature and the time interval required. It is important that the water is maintained at a uniform temperature throughout the container.
- Constantly stir the water while soaking the bag.
- Suspend the bag- do not let it touch the bottom of the pot.
- Remove the bag and emerge it in cold water to quickly stop the heating.
- Spread the seeds to cool and dry.
- Do not store treated seeds. Sow them on well-prepared seedbeds.

Meeting users' expectations : Regulatory authorities, seed distributors and seed users have established high standards for the seed and seed treatment industries regarding the quality of a seed treatment and its application to the seed. The expectations are that the treated seed will be easy to plant and that the seed treatment will be effective in the field, safe to the applicators, the growers and the environment. The industry recognises that seed treatment must provide “added seed value” (e.g. better emergence, higher seedling establishment, improved crop health, higher yields and improved crop quality). It expects

seed treatments to be easy to handle and apply to seeds, to complement and protect genetic improvements, to function as part of IPM, to be safe and cost effective in use and to reduce personal and environmental risks.

Dry seed decay: Dry seed decay occurs when seed is planted into soil too dry to allow for germination of the seed. Often this is done with the hope that rains will come to stimulate seed germination. However, when the seed sits in dry soil for 6-8 weeks prior to germination, *Penicillium* spp. will often infect the resting seed and destroy its ability to germinate. Such infected seed often appears blue due to the growth of the *Penicillium* fungus. Control of dry seed decay can be accomplished with a variety of fungicides, including some of the materials such as Captan, Maneb, Thiram, or Mancozeb.

Precautions in seed treatment : Most products used in the treatment of seeds are harmful to humans, but they can also be harmful to seeds. Extreme care is required to ensure that treated seed is never used as human or animal food. To minimise this possibility, treated seed should be clearly labelled as being dangerous, if consumed. The temptation to use unsold treated seed for human or animal feed can be avoided if care is taken to treat only the quantity for which sales are assured. Care must also be taken to treat seed at the correct dosage rate; applying too much or too little material can be as damaging as never treating at all. Seed with very high moisture content is very susceptible to injury when treated with some of the concentrated liquid products. If the seeds are to be treated with bacterial cultures also, the order in which seed treatments should be done shall be as follows (i) Chemical treatments (ii) Insecticide and fungicide treatments (iii) Special treatments. You should always read the label before proceeding and follow the label precisely. Some materials may not be poisonous, but dust from the

Seed treatment of major vegetable crops			
Crop	Pest/ disease	Seed treatments	Dose
Cruciferous vegetables	Soil and seed borne diseases (Damping off)	<i>Trichoderma viride</i> 1.15% W.P.	2g/100 seed
Leguminous vegetables	Wilt and damping off	<i>Trichoderma viride</i> 1% W.P.	9g/kg seed
Brinjal	Bacterial wilt	<i>Pseudomonas fluorescens</i>	10g/kg seed
	Soil borne infection of fungal disease	<i>Trichoderma spp.</i>	2g/100 seed
Ladies finger	Root knot nematode	<i>Pseudomonas fluorescens</i>	10g/kg seed as seed dresser
Tomato	Early blight, damping off, wilt	<i>Trichoderma viride</i> 1% W.P.	2g/100 seed
		Captan 75 WS	1.5 to 2.0 g a.i. /for soil drenching
Potato	Soil and tuber borne diseases	Carbosulfan 3% WS for seed treatment for 20 minutes before storage	0.25%
		Boric acid	3%

Fungicides and bio-fertilizers recommended for seed treatment				
Crop	Recommended fungicide	Quantity (per 10 kg)	Recommended biofertilizer	Quantity (per 10 kg)
Paddy	Thirum	30g	Blue green algae	250g
Wheat	Thirum	25g	<i>Azotobacter</i>	250g
Maize	Thirum	25g	<i>Azotobacter</i>	250g
Jowar	Thirum	30g	<i>Azospirillum</i>	250g
	Sulphur	40g		
Bajra	Metalaxill	60g	<i>Azospirillum</i>	250g
Groundnut	Mancozeb	30g	<i>Rhizobium</i>	250g
Soyabean	Thirum	25g	<i>Rhizobium</i> +PSB	250g
Gram	Carbendazim	15g	<i>Rhizobium</i> +PSB	250g
	Thirum	25g		
Pigeonpea	Carbendazim	15g	<i>Rhizobium</i> +PSB	250g
	Thirum	25g		

(PSB-Phosphate solubilising bacteria)

treatment may be irritating to the eyes and nose. Seed treatment is our first line of defense against plant disease.

Conclusion : Keeping in view of the importance of seed treatment to achieve better crop stand of major crops, and the fact that many farmers in the country do not follow/adopt this practice, adoption of seed treatment by the farmers across the country require effective extension strategies and making the appropriate chemical/bio-products available to the farmers at their doorstep. The farmers also required to be trained/made aware of the methods of seed treatment, post treatment- handling of

the seeds and planting materials. Government of India has therefore launched a country wide campaign for ensuring 100 percent seed treatment in all important crops during rabi season. Pesticide industry associations, ATMAs, KVKs, Farmers Clubs, SAUs, NGOs, etc.can play an important role in the campaign for 100 percent seed treatment and hence their participation is solicited. Lastly, it can be said that no seed shall be sown without seed treatment and an ounce of prevention is worth a pound of cure.

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