

Seed treatment

with botanicals: an indigenous technology

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Seed treatment is a term that describes both products and processes. The usage of specific products and specific techniques can improve the growth environment for the seed, seedling, and young plant. Seed treatment complexity ranges from a basic dressing to coatings and pelleting of seed.

Key words: Botanicals, Indigenous technology, Seed, Treatment

SEED treatment ‘means’ to give an application of chemical or subject compound to reduce, control or repel disease organisms, insects, or other pests which attack the seed or seedlings. The objective of Seed Treatment products is the superior control of certain insects and diseases while improving crop safety leading to good establishment of healthy and vigorous plants. Seed treatment formulations must also contribute to improvements in farmers’ and workers’ safety and stewardship of the environment. But the use of chemicals and their residual toxicity adversely affects non-target animals, including human beings as well as seed. Major diseases associated with seeds are seed rot-rotting of seed before germination, damping-off and seedling blight- soft rot of stem tissues near ground level and water soaking of seedling tissues, seedling wilt- gray colouration starting at the leaf tips and extending rapidly to the whole leaf, causing complete collapse of seedlings in 24 to 48 hr, root rot-water soaking, browning and sloughing of rootlets are loose and covered smut of small grains. The diseases and casual organism are: Damping off (*Pythium* spp.), Blight (*Fusarium* sp.), Wilt (*Diploida*, *Penicillium*), Blight (*Helminthosporium*), Smuts (*Ustilago*), Rot (*Rhizoctonia*), and

Approx. 2000 B.C. to 100 A.C.: First soaking techniques: Use of sap of onion or cypress (Egypt, Greece, Roman Empire)
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 (Germany)
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 in Western Europe
1990's: Introduction of new modern fungicides and insecticides viz; Thiram, Captan

Fig. 1. History of seed treatments

Anthracnose (*Colletotrichum*). The common insects associated with seeds are: rice weevil, cadelle beetle, saw-toothed, grain beetle, confused flour beetle, flat grain beetle, granary weevil, angoumois grain moth, lesser grain borer, and Indian-meal moth.

Until the second world war the only botanical pesticide used were pyrethrum, rotenone, nicotine, sabadilla and quassin. Rotenone is presently used only on a limited number of crops due to its high toxicity to fish. Natural pyrethrum from chrysanthemum flowers is employed mainly as a rapid knockdown agent for crawling and flying insect which

causes allergic to men and animals. Nicotine, Sabadilla and Quassin are seldom used as pesticide (Table 1). It is estimated that there are about 2,50,000 to 5,00,000 different plant species in the world. Only 10 % of this has been chemically examined. Of the different group of pesticides consumed in India, insecticides constitute about 80%. Botanical pesticide covers only 12 % worldwide and less than 1 % in India. The most promising botanicals for use are species of families such as Meliaceae, Rutaceae, Asteraceae, Malvaceae, Labiateae and Canellaceae (Table 2).

BOTANICALS

The ideal characteristics of botanicals perennial in nature, easy and inexpensive to grow; non-competitor for space, water or fertilizer etc. with the regular agricultural crops plants should have no potential to become weeds or the host for plant pathogens; the insecticidal product should effectively control the range of pests encountered in local storage situations; be easy to extract, formulate, store and use with available skills; and no environmental or other hazards.

Use of botanicals seed treatment

During seed treatment botanicals control a variety of diseases and

common storage insect pests which enhance storability of seeds. They are most effective in conditions of low humidity, because they introduce mortality by causing desiccation, *ie.*, water is lost because the dusts remove the waxy layer of cuticle in exoskeleton by adsorption. They have repellent action *eg.* they include vegetable oils (e.g., castor oil) and botanicals (e.g., sweet flag rhizome powder), (Table 3). These materials are most effective when applied as dusts formulation. Vegetable oils probably interfere with the respiratory mechanism of insect by restricting oxygen supply resulting in higher mortality of the insects due to suffocation in treated seeds.

Application of botanicals

Botanicals can be applied in various forms to seeds.

- **Seed dressing:** Treating the seeds with botanicals in the dust form.
- **Seed film coating :** Application of precise amount of active ingredients along with a liquid material directly on to the seed surface without obscuring its shape.
- **Seed colouring:** Application of precise amount of natural dyes or pigments directly on the seeds to improve its brand identity and marketability.
- **Seed pelleting:** Process of enclosing the seed with small quantity of ingredients along with filler materials to produce a globular unit of uniform size to facilitate precision planting.

With all these applications there are some limitations with botanical seed treatment. The botanicals are required in large quantities, new products are to be developed, which requires low humid condition.

Neem: It is the best example of botanical which controls almost each insect and disease (Table 2). The wonder tree of Indian origin has



Table 1. Botanical pesticides

Pesticide	Source	Limitations
Nicotine	<i>Nicotiana tabacum</i> , <i>N. rustica</i> , <i>N. glutinosa</i>	Toxic to mammals
Pyrethrum	<i>Chrysanthemum</i> , <i>Cinerariae folium</i>	Allergic people
Quassin	<i>Quassia amara</i> , <i>Aeschirion</i> spp., <i>Picrma excelsa</i>	Extremely bitter
Rotenone	<i>Derris elliptica</i> , <i>Lonchocarpus</i> spp., <i>Tephrosia</i> spp.	Toxic to fish
Ryanodine	<i>Ryania</i> spp.	Toxic to fish
Sabadilla	<i>Schoenocaulon officinale</i>	Toxic to mammals

Table 2. Botanicals used in seed treatments against pathogens

Test material	Dose	Test organism	Observation
<i>Azadirachta indica</i> (Neem oil)	0.01-0.5%	<i>Erysiphe polygoni</i>	Checked the growth of conidia
	1%	<i>Alternaria alternate</i>	Growth inhibition
	10%	<i>Fusarium moniliforme</i>	Growth inhibition

Table 3. Botanicals-vegetable oils

Carrot seed oil	<i>Aspegilus parasiticus</i>	Inhibits aflatoxin production
Cassia and clove oil	<i>A. flavus</i>	Growth inhibition in
	<i>Curvularia pallescens</i>	maize
	<i>Chaetomium indicum</i>	
Cinnamon and clove oil, Cinnamic aldehyde,	<i>A. parasiticus</i>	Inhibits aflatoxin production
Citrus oil	<i>Aspergillus parasiticus</i>	Inhibits aflatoxin production
Essential oils of <i>Oreganum vulgare</i>	<i>A. niger</i>	Inhibition of spore germination and mycelial growth
	<i>A. ochaceus</i>	
	<i>A. flavus</i>	
Soybean oil	<i>Aspergillus rubber</i> , <i>Zabrotes subfaciatus</i>	Reduction of infection in dry beans

Table 4. Botanicals-extracts

Botanicals	Scientific names	Extratcs
Garlic bulb extract	<i>Macrophomina phaseolina</i> , <i>Botryodiplodiathe obromae</i> , and <i>Colletortichum corchori</i>	Inhibited the spore germination mycelial growth in jute
<i>Myristica Jamaican</i>	<i>Staphylococcus aureus</i>	Antimicrobial
Nutmeg seeds extract	<i>Klebisella pneumoniae</i> , <i>Mycobacterium smegmatis</i> , and <i>Candida albicans</i>	
Peppermint and garlic extract	<i>Drechslera oryzae</i>	Reduced infection in rice seed

Table 5. Botanical oils / extracts as seed protectants

Test materials	Dose	Test organism	Observation
<i>Adhatoda vasica</i> (Malabar nut) alkaloid extract	0.5%	<i>T. castaneum</i>	Mortality (50 %)
<i>Ageratum conyzoides</i> oil (Goat weed)	0.5%	<i>C. chinensis</i>	Mortality 100%
<i>Annona reticulate</i> oil (Custard apple) emergence	0.1%	<i>C. chinensis</i>	Inhibited adult
<i>Annona reticulate</i> (Custard apple) oil ether extract	-	<i>C. cephalonica</i>	Moderately toxic
	-	<i>Triboliumcastaneum</i>	Moderately toxic
<i>Arachis hypogea</i> infestation	0.5%	<i>C. chinensis</i>	Checked the
	1%	<i>S. oryzae</i>	Mortality 100%
<i>Blend of soya and cotton seed oil</i> emergence	-	<i>C. rhodesianus</i>	Reduced adult
<i>Blumeabal samifera</i> (Sambong, camphor)	-	<i>C. chinensis</i>	Mortality 100%

Table 6. Effect of botanicals on seed viability

Test material/ Dose	Crop	Germination
Ground nut oil (0.25-0.75 %)	Blackgram	No reduction
<i>Blumeabal samifera</i> (5 ml/kg)	Wheat	Reduced up to 28 %
<i>Butea frondosa</i> (5 ml/kg)	Wheat	Reduced up to 8%
<i>Cocos nucifera</i> (5 ml/kg)	Greengram	No reduction
Soybean (5 ml/kg)	Chickpea	No reduction

Table 7. Findings of seed treatments on different crops

Crop	Findings
Brinjal	Seeds pelleted with <i>Albizia amara</i> , <i>Vitex negundo</i> , <i>Acacia nilotica</i> and <i>Pongamia pinnata</i> @ 300 g/kg leaf powder enhanced the fruit and seed yield
Cauliflower	Coating the seeds with botanicals improved the storability
Cotton	Seeds pelleted with <i>Albizia amara</i> leaf powder + <i>Azospirillum</i> improved the seed yield and quality
Gourds	Seeds pelleted with <i>Albizia amara</i> @ 500 g/kg leaf powder enhanced the germination and survival
Onion	Seeds pelleted with <i>Albizia amara</i> @ 300-400 g/kg leaf powder improved the germination
Papaya	Seeds pelleted with <i>Albizia amara</i> @ 400 g/kg leaf powder improved the germination
Tomato	Fresh and old seeds pelleted with <i>Pongamia pinnata</i> leaf powder @ 200 g/kg improved germination

received global attention over the last three decades.

- Its seeds are rich source of tetra nortriterpenoids and diverse non-isoprenoids.
- The most biologically active constituent of neem has been highly oxygenated azadirachtin.
- Its natural analog and derivatives viz., azadirachtins B to K are either minor constituents and they are biologically less active.

Besides above discussed Botanical extracts (Tables 3, 4), Botanical oils/extracts as seed protectants (Table 5), effects of botanicals on seed viability (Table 6), and findings on different crops (Table 7) are given in brief in their corresponding tables.

ADVANTAGES

The advantages of botanicals over chemicals are discussed here.

- Botanical insecticides tend to have broad-spectrum activity and bio-degradable pesticides with greater selectivity.

- Safe, relatively specific in their mode of action.
- Easy to process and easy to use.
- Farmers and small-scale industries can often easily prepare botanical insecticides.
- Developed from the indigenous plant and formulated locally with indigenous materials available so these are safe for higher animals and natural enemies environment. Thus aid in saving farmers money and contributes to nations valuable foreign exchange.

DISADVANTAGES

The disadvantages of chemicals over botanicals are given here.

- Higher cost and hazardous to humans.
- Soils-borne pathogens especially root rot pathogens are very difficult to control with these chemicals. Because resistance against widely used chemicals by pathogens gradually increasing.
- They are highly resistant to

degradation. Many of these chemicals are bio-accumulative (i.e., they are transmitted up to food chain).

- They pollute soil and water and kill many useful micro-organisms, which take part in nutrient cycle.

SUMMARY

Seed treatment with botanicals is the best alternative to chemical seed treatment and botanicals are ecologically safer and economically viable provides support to small-and marginal-farmers. The most promising botanicals are derived from *Azadarachta indica*, *Acorus calamus*, *Chenopodium album*, *Eucalyptus* sp. *Mentha arvensis* and *Asofoetida*. These botanicals have the property of controlling number of fungal, bacterial, viral and nematode diseases and storage pests in seed crops. Further, it is felt need to explore and identify the new insecticides of plant origin to protect the seed crops and storage pests and diseases. Besides, there is scope for revalidating the some of the indigenous technical knowledge to preserve the farmers saved seeds for sustainable crop production and productivity.

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Jai Kisan, Jai Vigyan

- A total of ₹ 788.33 crores have been sanctioned for opening six new agricultural colleges for eastern India under Central Agricultural University, Imphal, and a new Central Agricultural University in Meghalaya.
- For the establishment of two new agricultural research institutes in Asom and Jharkhand, a sum ₹ 100 crores is allocated.
- First academic session of the Rani Lakshmbai Central Agricultural University has been allocated for four new agricultural colleges in Datiya and Jhansi.
- An Memorandum of Understanding was signed for transforming the Rajendra Central Agricultural University, Pusa, Samstipur, Bihar. A proposal of ₹ 400 crores is submitted in EFC.
- Post-Graduate Institute of Horticulture is being established in Amritsar, Punjab.
- Foundation stone of the Indian Institute of Agricultural Biotechnology is laid at Ranchi for promoting agricultural biotechnology.