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Changes in Concepts in Seed Treatment and Treatment Materials

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CHANGES IN CONCEPTS IN SEED TREATMENT AND TREATMENT MATERIALS

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Seed treating has become a standard practice and an adjunct to seed processing as a means of maximizing crop performance. In a broad sense, seed treatment is any additive or process utilized to improve potential performance. But it is not in a static condition. Today, more than ever before, changes are occurring in methods and materials. Some of these changes represent the usual evaluation of better materials and processes, while others are the result of changes of attitudes toward what constitutes safety in the environment.

WHY TREAT

With the present high investment in land, equipment and land preparation, and in the use of herbicides that affect both replanting and rotation considerations, the grower cannot afford to replant because of disease if any other alternative is available. Adequate fungicides as part and parcel of fully-processed seed are his best insurance.

Treating seeds with a fungicide is one means of getting rid of certain seed-borne, disease-producing organisms, such as the loose and covered smuts of grain, anthracnose and bacterial blight of cotton, barley stripe or wheat scab. This is termed disinfesting or disinfection. The mercurial fungicides have set the standard of attainment. Hot water treatment may also be used to disinfect, or seed production can be restricted to arid regions of low disease incidence to produce bacterial blight-free bean seed.

Seed treated with a fungicide is one means of supplying a protective barrier against soil-borne organisms such as Pythium, Rhizoctonia, Fusarium and Thielaviopsis that may rot the seed or blight the developing seedling. Such treatments are called protectants. The need for protectants increases in proportion to the adversity of the germinating condition. This adversity is utilized in so-called "cold tests" to measure potential field performance. The treated seed is germinated at reduced growth temperatures in the presence of some field soil. Dust and slurry products based on captan and thiram have been the standard protectants.

An insecticide may be added with the fungicide to protect the seed from storage insects and the seedling from certain soil insects.

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We may utilize the seed as a vehicle for placement of a systemic fungicide or insecticide to permit root uptake.

THE MERCURIALS

Certain volatile mercurials, such as those used in "Panogen" and "Ceresan" products and referred to as alkyl mercuries were the standards for the treatment of small grains and cotton-crop seeds that are highly tolerant to mercury. The wide acceptance of these mercurials relates to (1) high disinfecting properties; (2) volatility that assured more complete coverage through the movement and adsorption of vapors into cracks, creases and under hull seed parts; (3) effective retention in the seed coats to effect good seed-rot protection; (4) relatively low cost; and (5) the convenience of liquid formulations, once suitable treating machines were developed.

The cancellation of mercurials opens consideration for certain older materials, such as maneb, as well as offering a continuing opportunity for the development of new and better treatments. Unfortunately, the costs will probably be higher, and new treatments may be more difficult to use. New products will require considerably more research information for registration thus increasing costs.

SPECIFICS AND SYSTEMICS

Some of the newer chemicals, and particularly those we term systemics, justify a brief word. In developmental efforts for more effective, broad spectrum fungicides, it appears that a plateau has been reached. But there is progress with materials that have high selective and/or systemic properties. It is the greater fungicidal actions of these specific fungicides as contrasted to broad protective action that makes them of interest even though they are selective. After all, we are dealing with the effects of chemicals on protoplasm which is common to both the fungus and the host plants. This fact gives researchers a narrow margin within which to work.

Sometimes two or more compounds are combined in the treater tank to give the spectrum of activity needed. We can add "Dexon" for Pythium, Streptomycin for bacteria, PCNB for Rhizoctonia or "Demosan" chloroneb fungicide for seedling protection against both Pythium and Rhizoctonia. Materials may be combined in a product such as maneb-captan (TSP-75) for peanuts and thiram + "Demosan" for cotton and PCNB + "Terrazole" (Terra-Coat L-21) for cotton.

The conventional fungicides either specific or broad spectrum are non-systemic protectants. Effective use requires complete coverage of the seed surface and treatment doesn't have much influence beyond that point.

The desirability of having materials that would move inside the plant to reach a fungus which is not influenced by the protectant has long been recognized. Such a material is called a systemic or therapeutant. It moves through the host plant to control or retard the growth of the fungus without affecting the host's metabolic system.

There are now a number of systemic fungicides that will have applicability to seed use. They are all selective or specific and should be used in conjunction with a seed protectant that covers the gaps. These new systemic fungicides include:

1. "Demosan" chloroneb fungicide in which roots of dicotyledonous plants pick up the fungicide and concentrate it in the hypocotyl region to protect the seedlings or make them resistant to attack from Rhizoctonia and Pythium.

2. "Benlate" benomyl fungicide which, when applied to small grain seeds, controls not only bunt or covered smut, but also is taken into the seedling to control the internal loose smuts. These smuts were previously controlled only by the hot water or cold water soak treatment. It has high activity for Rhizoctonia, Fusarium, Thielaviopsis, anthracnose and powdery mildew. It may be combined with thiram to complete the spectrum. "Benlate" is not, as yet, registered for commercial use as a seed treatment.

3. "Vitavax" carboxin fungicide will control the smuts similarly to "Benlate" benomyl fungicide. "Vitavax" is also active against Rhizoctonia and Helminthosporium. It may be combined with thiram or captan for seed-rot protection.

4. There are some materials of European origin that will be evaluated in the United States. Suffice it to mention two related compounds: ethirimol, specific for powdery mildew of cereal, and dimethirimol, specific for powdery mildew of cucurbits.

REPLACEMENT TREATMENTS FOR SMALL GRAINS

Because mercurials in the past were effective, there was no pressing need to search for other treatments nor for the experimental stations to maintain extensive test programs. Dr. E. D. Hansing at Kansas State University has a program under way to give some of the answers on replacement treatments. His seed treatment evaluations are reported in their Chemical Task Force reports.

As replacements for the mercurials, the familiar seed protectants based on thiram or captan will prove reasonably suitable for wheat, barley and rye, except under extreme smut and Helminthosporium fungus infestations. They are solids that must be applied either as dusts or slurries. Thorough seed coverage is essential, but there is some question whether they will prove adequate for oats where the smut spores and Helminthosporium fungi are present under the hulls.

Maneb is an effective treatment at planting time. It probably doesn't have the seed storage stability of thiram or captan, but it is more effective than either one in its disinfesting properties particularly needed for oats.

HCB (hexachlorobenzene) has long been a specific for bunt or smut of wheat. It has been widely used in the Pacific Northwest because of its unique control of soil-borne bunt that occurs in that area. It is not effective for smut of the other grains or for seed rot or seedling blight organisms, but may be combined with captan to control these problems.

New treatments may be expected to come on rapidly. "Vitavax" is presently cleared for seed production grain. "Terra-Coat" L-205 will be in development phases. "Benlate" T, a mixture of benomyl and thiram, and maneb mixtures are being evaluated.

REPLACEMENT TREATMENTS FOR COTTON

The Cotton Disease Council conducts beltwide seed treatment trials on cotton annually. These tests give the relative performance of accepted as well as experimental compounds and the results are made available. There are a number of suitable treatments for cotton that include thiram and captan combined with "Demosan" chloroneb fungicide as well as newer materials such as "Terra-Coat" L-21, "Busan", "Daconil" and "Vitavax". The major question for the future is what happens to anthracnose and bacterial blights which were eliminated in many areas through the use of mercurials.

Today in seed treatments we are temporarily at a point of disruptive change. The relatively stable mercury seed treatment period is over. Many new compounds are being evaluated and new approaches in seed treatment are forthcoming. Hopefully, this new challenge will produce seed treatments that will eventually surpass those of the past and be more acceptable in the broad ecological picture.

Table 1. Effect of seed treatment on control of seed decay, seedling blight, and bunt of wheat. E. D. Hansing, Kansas Task Force Reports, August, 1970.

Treatment	Form[1]	Rate oz/bu	Percent emergence			Percent bunted spikes Days planted after treating		
			Guide	Shawnee	Mean	5	8	23
Check, not treated	--	--	64	74	69	35	52	91
Fungicide check								
Ceresan L	L	0.5	78	82	80	0	0	0
Panogen 15	L	0.75	80	83	81	0	0	T[2]
Mercurial fungicide								
Panogen 15	L	0.5	--[3]	--	--	0	1	2
PMAA 3.5	L	0.5	68	78	73	1	2	4
PMAA 3.5	L	1	70	78	74	T	1	2
Nonmercurial fungicide								
Arasan 75	WP	1.33	84	87	86	1	3	9
Arasan 75 + Benlate	WP	0.5+1.5	81	82	81	T	0	0
Arasan 75 + Benlate	WP	1 + 2	80	80	80	0	0	T
Arasan 75 + Benlate	WP	1.5+1.5	80	84	82	T	T	1
Benlate	WP	2	62	75	68	0	T	2
Captan 80	WP	1.25	85	85	85	1	6	18
Captan-Dieldrin 60-15	WP	1.67	81	85	83	2	5	22
Delsan A-D	WP	1.67	79	83	81	1	4	18
DB-Green	P	2	78	83	81	1	2	4
DB-Green	P	4	84	85	84	0	1	2
DB-Yellow	P	2	81	79	80	1	3	5
DB-Yellow	P	4	85	83	84	1	1	1
Dithane M-45	WP	1	80	84	82	1	3	5
Dithane M-45	WP	1.5	78	83	81	T	2	3
Dithane M-45	WP	2	84	86	85	T	1	2
Dithane M-45	WP	2.5	80	88	84	0	1	2
Granol N-M	P	2	77	81	79	1	4	10
Granol N-M	P	4	77	83	80	T	1	3
Granox N-M	P	2	78	82	80	0	0	0
Granox N-M	P	4	79	84	82	0	0	0
Polyram 53	WP	2	78	79	78	0	2	4
Polyram 53	WP	3	79	81	80	0	0	2
Polyram 53	WP	4	78	80	79	0	0	2
Polyram 80	WP	2	76	84	80	T	0	2
Terrazole 95	L	1.05	78	81	80	27	35	82
Vitavax	WP	1.2	71	79	75	2	4	18
Vitavax	WP	2.4	81	83	82	1	4	7
Vitavax +	WP	0.6+	84	85	84	5	5	22
Terrazole 95	L	0.47						
Vitavax +	WP	1.2+	80	82	81	1	6	12
Terrazole 95	L	0.95						

[1] L = liquid, WP = wettable powder, P = Powder. [2] T = trace = 0.1 to 0.5 percent.
[3] -- = fungicide not included for emergence.

Table 2. Effect of seed treatment on control of loose and covered smuts of oats. E. D. Hansing, J. C. Reyes and A. Baig, Kansas Task Force Reports, August 1970.

Treatment	Form[1]	Rate oz/bu	Percent smutted panicles Days planted after treating 2	13
Check, not treated	--	--	17	26
Fungicide check				
Ceresan L	L	0.5	2	3
Panogen 15	L	0.75	1	4
Mercurial fungicide				
PMAA 3.5	L	0.5	11	16
PMAA 3.5	L	1	7	14
Nonmercurial fungicide				
Arasan 75	WP	1.33	6	10
Arasan 75 + Benlate	WP	0.67 + 1	T[2]	1
Arasan 75 + Benlate	WP	1.33 + 2	0	0
Benlate	WP	1	0	T
Benlate	WP	2	0	0
Captan 80	WP	1.25	9	13
Spergon	P	2.08	7	14
Vitavax	WP	0.67	0	T
Vitavax	WP	1.33	0	0

[1]L = liquid, WP = wettable powder, P = powder.

[2]T = trace = 0.1 to 0.5 percent.