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### Seed Treatment Chemicals

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## Seed Treatment Chemicals

### Comments

Update on current U.S. seed treatments and future prospects

## SEED TREATMENT CHEMICALS

John J. MacFarlane <sup>1/</sup>

It is a pleasure to again appear as a speaker at the Mississippi State University Short Course for Seedsmen and to discuss the topic of seed treatment chemicals. During the two years since I discussed this topic at the 1979 Short Course, there have been only a handful of new chemicals registered for seed treatment in use in the United States, and only another few products whose labels have been expanded to include additional major seed treatment uses on other crops or against other pests. Notable examples are the registration of Orthene for seed treatment of cotton, Mertect as a seed treatment for wheat to control TCK or dwarf bunt, Kathon as a seed treatment for cottonseed, and EPA expansion of the Vitavax-200 label for soybeans. Also, since the 1979 Short Course, we have seen some of our most important seed treatment chemicals come under regulatory scrutiny by the government; notably, Captan and Lindane are officially undergoing RPAR, Thiram and several other chemicals are slated as Pre-RPAR candidates, further manufacture of Phenyl Mercury has been halted and Heptachlor currently is in a government "phase-out" program. Additionally, we've seen the new Resources Conservation and Recovery Act (RCRA) enacted into law, which has caused many seedsmen concern over disposal of chemically treated seeds.

Turning now to the present and future, we will consider all major viable seed treatment chemicals currently in use in the United States, and I will update you on important matters of formulation, labeling, and regulation which have recently occurred or that we anticipate occurring in the near future. We will also talk about several new chemicals on the horizon in each of the categories that we believe will be registered within the next one to four years in the U.S. Frankly, some of these compounds are quite exciting and will fill voids which have existed in the seed trade for several years. Specifically, I will talk about a new systemic fungicide which gives excellent control of Phytophthora root rot of soybeans in the seedling stage, a new systemic insecticide which gives excellent control of the newly discovered biotype E of the sorghum greenbug in the seedling stage, and a revolutionary new broad spectrum storage insecticide which will be used on planting seed as well as edible grains.

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In this discussion, I will talk about fungicides by category of activity (contact type, local or semi-systemic type, and true systemic type), insecticides by category (contact type, and systemic type), growth regulant compounds, and lastly, about miscellaneous compounds, such as safening aids, conditioning aids, seed applied herbicides, etc.

### I. Contact Fungicides

This group of fungicides has contact or protectant activity and is not absorbed into plant tissue, or translocated through the plant.

#### A. Captan

--Manufactured in the U.S. by Stauffer and Chevron; made in Israel, Taiwan and Mexico also.

--Broad spectrum for control of many seed-borne and soil-borne diseases; registered for seed treatment of almost all major crops.

--Highly active against Pythium.

--Currently under RPAR, but excellent chance for retaining most all seed treatment uses.

--Most widely used seed treatment fungicide in the United States.

#### B. Thiram

--All technical Thiram is imported into the U.S.; several viable seed treatment formulations made in U.S. - notably, DuPont and Gustafson.

--Broad spectrum activity against many seed- and soil-borne diseases.

--Registered for treatment of most all types of crop seed.

--Wettable powder and dust formulations cause irritation to skin and mucous membranes of many individuals.

--It is the second most widely used seed treatment fungicide, alone or in combinations.

#### C. HCB

--Formerly manufactured by Hooker Chemical Company in the U.S.

--Popularity as a seed treatment has declined drastically in the past four years because of environmental concerns; the only U.S. manufacturer voluntarily ceased production in 1977.

- Suspected to have extremely long residual; it is classified as a chlorinated hydrocarbon.
- Greatest utility in the U.S. for the control of surface-borne smuts of small grains; specific activity against bunt of wheat.

D. TCMTB

- Manufactured in the U.S. by Buckman Laboratories.
- Has a broad spectrum of activity against many major seed- and soil-borne organisms and is registered for seed treatment of many crops.
- Has shown most activity against certain species of bacteria and storage insects.

E. PMA

- Formerly manufactured in the U.S. by Gustafson; further manufacture prohibited in late 1978.
- Use of existing stocks still legal, but stock cannot cross state lines.

F. Difolatan

- Manufactured in U.S. by Chevron.
- Chemically very closely related to Captan.
- Excellent activity against Pythium and Achyla.
- Registered for seed treatment of cotton and rice.
- Can cause skin reactions in some people.

G. Terrazole

- Manufactured in the U.S. by Olin Corporation.
- Registered for seed treatment of cereal grains, cotton and many other types of seed.
- Relatively broad in spectrum; especially effective against Rhizoctonia.

H. Maneb & Coordinated Zinc Mixtures with Maneb

- Manufactured in the U.S. by DuPont and Rohm & Haas.
- Broad in spectrum and registered for treatment of many types of crop seed.

I. Heavy Metal Fungicides

- Manufactured in the U.S. by a number of firms; Kocide Chemical Company manufactures a series of organic copper fungicides.
- Registered for seed treatment of many types of seed for controlling seed-borne blight and various soil-borne and seed-rotting organisms.

J. Kathon

- Manufactured in the U.S. by Rohm & Haas.
- Recently registered in the U.S. for seed treatment of cotton.
- Long residual and broad activity against major seed- and soil-borne fungi attacking cotton as well as some species of bacteria.

K. Botran

- Manufactured in the U.S. by the Upjohn Company.
- Spectrum of activity includes many soil-borne pathogens such as Rhizopus, Botrytis and Aspergillus.
- Commonly used as a seed treatment for peanuts usually in combination with Captan, Thiram or Difolatan.
- Also used as a dyestuff intermediate for yellow dyes.

L. Lesan

- Manufactured in the U.S. by Mobay.
- Especially active against Pythium.
- Has utility as a seed treatment on cotton seed and sugar beets.

## II. Locally or Semi-Systemic Fungicides

This group of fungicides is locally absorbed into the epidermal or sub-epidermal layers of plant tissue and is sometimes translocated between cells.

A. Demosan

- Manufactured in the U.S. by DuPont.
- Most often used as a seed treatment for cottonseed, certain edible beans and soybeans.
- Active against various seedling blights, Rhizoctonia, Sclerotium and Pythium.
- Treated crops cannot be grazed until after 45 days.

B. Terrachlor

- Manufactured in the U.S. by Olin.
- Has a broad spectrum of activity, especially on bunt of wheat and Rhizoctonia.
- Registered for seed treatment on many crop seeds.

C. Rovral

- Manufactured by Rhone-Poulenc Company.
- Broad spectrum against many major seed- and soil-borne pathogens, Rhizoctonia, Aspergillus and Rhizopus but does not control Pythium.
- Currently has no registration for seed treatment in the U.S. but is registered for seed treatment in various European countries.
- Will probably have good utility as a potato seed piece treatment.

## III. True Systemic Fungicides

This group of fungicides is readily absorbed and translocated throughout the seedling when applied as a seed treatment.

A. Vitavax

- Manufactured by Uniroyal, Inc.
- Registered for treatment of cereal grains, cotton, peanuts, rice and corn.
- Highly active against Basidiomycetes, especially Rhizoctonia and Helminthosporium.

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--Also very active against internal smuts of cereal grains.

--EPA registered for soybean seed treatment in mid-1980.

--Currently has tolerance pending on edible beans.

B. Mertect

--Manufactured in the U.S. by Merck and Company

--Registered for treatment of wheat for control of dwarf and common bunt in the U.S.

--Has excellent activity against Fusarium.

C. Apron

--A product of CIBA-GEIGY Corporation.

--Highly systemic in nature with specific activity against Phycomycetes, especially Pythium, Phytophthora and the downy mildews.

--Registration application will be submitted to the EPA during the fourth quarter of 1981 for cotton.

D. DOWCO 444

--Manufactured by Dow Chemical Company

--Very similar spectrum to APRON but registration progress about two years behind.

--Expected to have excellent utility as a soybean treatment against Phytophthora.

E. Topsin-M

--Manufactured in Japan; U.S. marketing and distribution rights held by Penwalt Corporation.

--Very similar in spectrum and chemistry to BENLATE.

--Main disadvantage is that compound rapidly hydrolyzes in water so it can only be used as a dry dust treatment.

--Currently being targeted for use as a potato seed piece treatment in combination with other fungicides.

F. Benlate

- Manufactured in the U.S. by DuPont.
- Controls internally borne smuts of cereals but not registered in the USA for this use.
- Currently registered in the U.S. only in the Pacific Northwest for "blackleg" of crucifers and in Florida for sweet corn seed treatment in combination with Difolatan.

G. Baytan

- A product of Mobay.
- Not yet registered in the U.S. for seed treatment but is registered in commercial use in Europe.
- Has similar spectrum of activity to VITAVAX.
- Gives control of loose and common smut of cereals and also controls rust in the seedling stage.
- Has a tendency to be phytotoxic under stress planting conditions so is being tested in combination and at low rates.

H. Campogran

- A product of BASF Wyandotte Corporation.
- Has excellent systemic activity and is being targeted as a seed treatment for cotton against Rhizoctonia, cereal grains against internal smuts, and for peanuts.
- Target for U.S. registration is mid-1985.

I. Trivax

- Product of Uniroyal
- Excellent activity against internal smuts of cereals; three to five times more active than VITAVAX.
- Currently registered and in general use in Australia; decision to pursue registration in the U.S. not yet made.

J. Imazilil

- Product of Jantzen Laboratories.
- Currently being tested as a seed treatment in the U.S. by various firms in combination with other fungicides
- Has excellent activity against Thelaviopsis of cotton and "take-all" of wheat.

K. Streptomycin

- Seed treatment formulations manufactured in the U.S. by Pfizer and Merck.
- Excellent activity against bacterial decay organisms; has particular utility as a potato seed piece treatment and as a control for halo blight of edible beans.

## IV. Contact Insecticides

This group of insecticides has contact or protectant activity and is not absorbed into plant tissue, or translocated through the plant.

A. Malathion

- Manufactured in the U.S. by various firms but first by American Cyanamid Company; classified as a organophosphate insecticide.
- Very low toxicity and relatively short residual.
- Commonly used as a storage insecticide for seed and edible grains.
- Certain storage insect species have shown resistance.
- Generally speaking, has its greatest activity against storage pests of the order Lepidoptera.

B. Methoxychlor

- Manufactured by a few chemical firms in the U.S. but originally manufactured by DuPont.
- Classified as a chlorinated hydrocarbon insecticide.
- Has longer residual than MALATHION and is also very safe to use, having only about one-fourth (1/40) the toxicity to mammals as DDT.

--Probably the most widely used seed treatment insecticide against storage insects in the U.S.; generally used in combination with fungicides.

--Generally speaking, has its greatest activity against storage insect pests of the order Coleoptera.

C. Lorsban

--Manufactured in the U.S. by Dow Chemical Company.

--Classified as an organophosphate insecticide.

--Is registered in the U.S. for treatment of cottonseed, edible beans, sweet corn and field corn.

--Normally used by seed treaters against soil insects, such as seed corn maggots and seed corn beetles.

D. Reldan

--Manufactured by Dow Chemical Company.

--Classified as an organophosphate insecticide; very closely related chemically to Lorsban.

--Already registered and in commercial use as both a seed treatment and edible grain treatment in various Soviet bloc countries, Western Europe and Australia.

--Targeted to be a direct replacement for MALATHION.

--U.S. registration expected during the first quarter of 1982.

E. Actellic

--A product of ICI.

--Classified as an organophosphate insecticide.

--Has been used a stored seed and grain insecticide in various parts of Europe, Australia and Latin America; has quick knock-down and broad spectrum of activity against most storage pests.

--Probably will not be registered in the United States for seed and grain treatment because of recent toxicology problems.

F. Diatomaceous Earth

- Is a naturally occurring compound which is mined by several companies in the U.S.
- Is a stable, essentially inert, basically non-toxic compound containing approximately 90% silica.
- Mode of action is interference with respiration of insects by physical damage to the spiracles.
- Exempt from requirement of EPA registration.
- Used by certain seed conditioners for treatment of grass seeds and sorghum.

G. Lindane

- Manufactured by several firms but first by Chevron and ICI.
- Classified as a chlorinated hydrocarbon insecticide.
- Has a long residual, has some fumigant activity, and is relatively toxic to mammals.
- Used in seed treatment mainly as a soil insecticide against wireworms, false wireworms, seed corn beetles and seed corn maggots.
- Currently under RPAR but it is very likely that seed treatment uses will be retained.

H. Diazinon

- Manufactured in the U.S. by CIBA-GEIGY Corporation.
- Is classified as an organophosphate insecticide.
- Used as a seed treatment on certain edible beans and peas as a soil insecticide against seed corn maggots.

I. Heptachlor

- Manufactured in the U.S. by Velsicol Chemical Company.
- Is classified as a chlorinated hydrocarbon insecticide.
- Has a long residual and is classified as very toxic to humans.
- Has some fumigant activity.

--Used as a seed treatment on various cereal and grain crops for control of soil insects, such as wireworms, false wireworms and seed corn maggots.

--Currently on a "phase-out" program at EPA; registrants are on allocation plan at this time and no further manufacture for seed treatment uses will be allowed after July, 1982.

#### J. Pyrethrums

--Formulated in the U.S. by a few companies; is a naturally occurring botanical insecticide from extracts of chrysanthemum flowers.

--Surprisingly, it is fairly toxic to humans; also, many people are allergic.

--When used as a seed treatment, it normally is used in combination with a synergist such as Piperonyl Butoxide; has fairly short residual.

--Used only as a storage insecticide.

### V. Systematic Insecticides

This group of insecticides is readily absorbed and translocated throughout the seedling when applied as a seed treatment.

#### A. Di-Syston

--Manufactured in the U.S. by Mobay Chemical Company.

--Classified as an organophosphate insecticide.

--Registered in the U.S. for seed treatment of cottonseed only for control of post-emergent insects, such as aphids and thrips, as well as mites.

--Extremely toxic to humans.

#### B. Thimet

--Manufactured in the U.S. by American Cyanamid Company.

--Classified as an organophosphate insecticide and very closely related chemically to Di-syston.

--Registered in the U.S. for seed treatment of cottonseed only; has basically the same claims on the label and same spectrum of activity as does Di-syston.

--As is Di-syston, extremely toxic to humans.

C. Go-Better (Azodrin)

--Manufactured in the U.S. by Shell Chemical Company and registered as a seed treatment by Growth of the Southwest, Inc.

--Classified as an organophosphate insecticide.

--Registered in the U.S. for treatment of cottonseed only for control of thrips, aphids and whiteflies.

--Approximately 1/4 the toxicity to humans as Di-syston and Thimet, but still classified as extremely toxic.

--Treated seed are highly toxic to birds and other wildlife.

D. Orthene

--Manufactured in the U.S. by Chevron Chemical Company.

--Classified as an organophosphate insecticide.

--Registered in the U.S. for treatment of cottonseed only for control of thrips, cotton aphids, and greasy black cutworms.

--Use as a cottonseed treatment is increasing rapidly in the U.S. due to the much, much greater safety of the product to humans.

E. Furadan

--Manufactured in the U.S. by FMC Corporation.

--Classified as a carbamate insecticide.

--Registered in the U.S. on a state label in Texas only for seed treatment of sorghum for control of greenbugs.

--Marketing of this product by FMC as a seed treatment has been halted in the U.S. due to highly toxic nature of treated seeds to birds.

F. Advantage

- A product of FMC Corporation.
- Classified as a carbamate insecticide.
- Closely related chemically to FURADAN.
- Decision to develop this product as a seed treatment in the U.S. is still undetermined; possibly has greater safety to birds than does FURADAN.

G. Bendiocarb

- A product of FBC Chemical Company (joint venture between Fisons Ltd. and Boots, Inc.).
- Classified as a carbamate insecticide.
- Already being marketed in the U.S. under an experimental use permit as TATTOO in the granular form for corn rootworm; also being marketed in the U.S. under the name FICAM for various public health and industrial pest control uses.
- Currently being rapidly developed in the USA as a seed treatment for sorghum for control of greenbugs and cinch bugs; appears to be very active against new bio-type of greenbug for which previously resistant hybrids have no resistance.
- Also appears to be very active against soil insects such as wireworm.
- Appears to be phytotoxic on cottonseed so probably will not be developed for that market.
- Registration in the U.S. as a seed treatment expected in early 1983.

## VI. Growth Regulants

A. BASF - 106

- A product of BASF Corporation.
- Chemistry is undisclosed at this time; actual mode of action is also undisclosed at this time, but compound appears to be of the retardant type.

--Seed treatment of sorghum is the number one target and the concept is to, by treating seed, make nondrought-resistant hybrids more drought resistant.

B. Tex-1

--A product of Eastman-Kodak, the development of which had been explored by Gustafson, Inc.

--Now classified as a dead product due to extreme problems in application which make commercialization as a seed treatment impractical and uneconomical.

C. W-17

--A product of Gustafson, Inc.

--Chemical composition not disclosed.

--Mode of action is that of a "sleeping pill" - the aging process of treated soybean seeds is tremendously decelerated.

VII. Miscellaneous

A. Concep

--Manufactured in the U.S. by CIBA-GEIGY Corporation.

--Is exempt from requirement of a registration, but is in commercial use in the U.S. as a seed treatment for sorghum as an herbicide safener.

--Basic mode of action is that treated seed are rendered physiologically different, by virtue of being treated, than other grass seeds in the same soil.

B. Screen

--Manufactured in the U.S. by Monsanto.

--Is exempt from requirement of a registration and currently being rapidly developed as a seed treatment for sorghum as an herbicide safener.

--Not yet in commercial use in the U.S.

--According to the manufacturer, has same basic mode of action as CONCEP, but has less sensitivity with regard to dosage rate and sequence of application on seed than CONCEP.

--Expected to be commercially available for seed treatment of sorghum in the U.S. in the fall of 1982.

#### C. Protect

--Manufactured in the U.S. by Gulf Chemical Company.

--Exempt from requirement of registration.

--Was the first physiologically active herbicide safener to be commercialized in the U.S.

--Main utility has been to safen rice seed from damage by PROPANIL Herbicide.

#### D. Shock Absorbers

--A group of polymer chemicals currently being developed by Gustafson in the U.S. for treatment of various delicate types of seed.

--All these compounds are FDA approved as food additives so would be exempt from registration and if applied to seed, would not cause the seed to be classified inedible.

--Basic activity is to provide a physical barrier to the seedcoat of various delicate seeds and reduce mechanical damage during handling.

#### E. Mesuro1

--Manufactured in the U.S. by Mobay.

--Currently registered as a planter box treatment for field corn as a bird repellent in certain states of the U.S.

--According to the manufacturer, probably would not have utility as a bird repellent for rice seed, since treated seed are much more likely to be injured by PROPANIL herbicide than are untreated seed.

#### F. VITAVAX

--A product of Uniroyal and currently being widely used as a systemic fungicide in the U.S. on many major crops.

--Currently being tested as a safening aid on wheat to reduce damage from FARGO herbicide and on soybeans to reduce damage from various herbicides, particularly SENCOR.

#### G. Super Slurper

--Currently being developed in the U.S. by Henkel Company as a seed treatment for several types of seeds.

--Basic activity is that of a moisture absorbing coating to insure rapid germination and early seedling growth of seeds in soils with marginal moisture.

#### H. Eptam

--Manufactured in the U.S. by Stauffer Chemical Company.

--Of course, Eptam is a widely used and well-known herbicide for several crops; basic concept is to coat alfalfa seeds with Eptam herbicide to provide weed control during the early seedling establishment period in close proximity to where the seed is planted.

--Pioneering work on this concept was done in Argentina and is currently being explored for registration and marketing feasibility in the USA.

#### I. Trace Elements

--There are several companies in the U.S. which have commercially available formulations of trace elements for seed treatment.

--Among the most common elements used commercially are sodium molybdate as a seed treatment for soybeans and zinc as a seed treatment for rice.

### Summary and Conclusions

In summary and conclusion, we at Gustafson and our colleagues in the seed treatment chemical industry are extremely excited about several new products on the horizon for seed treatment use in the United States. We feel that some of these new compounds will efficiently and economically solve problems which have heretofore been unsolved. We know from our experience in the market place and from multiple detailed surveys that the American farmer is becoming more and

more aware of the benefits and returns on investment possible from seed treatment. Realizing that seed treatment is one of the most economical and efficient methods of pesticide application available we feel that our industry will continue to be of increasing importance to American agriculture and that seed treatment will continue to provide the American farmer with one of the greatest (if not the greatest) returns on his investment of any single crop production practice available to him.