Pest Control by Seed Treatment

wireworms and seed-corn maggots can be controlled by treating seed with lindane prior to planting

W. H. Lange, E. C. Carlson, and L. D. Leach

Seed treatment with lindane has proved to be an effective, economical and relatively safe method for the control of wireworms and the seed-corn maggot affecting germinating seeds of a number of vegetable and field crops.

Seeds can be treated with lindane or other insecticides in the same manner that fungicides are applied. Insecticides should be used with an adequate fungicide and the two applied at the same time. Insecticides often increase pre-emergence seed decay if they are used alone on seeds.

The different application methods are:

1. The dust method, in which a measured amount of insecticide and fungicide are applied to the seed in rotating barrels, cement mixers, or other acceptable dust mixers.

2. The liquid fixation method, where after the dusts are applied to the seeds, one quarter pint to one-half gallon of water is sprayed on each 100 pounds of seed by means of a sprayer.

3. The spray method, in which liquid insecticides and fungicides are applied to seed in a batch or continuous mixer.

4. The slurry method, in which a thick suspension of chemicals is applied to the seed by means of a slurry treater.

The best method to use will depend upon the quantity of seed to be treated, the seed type, the chemical or chemicals to be used, and the availability of equipment. In general it is better to apply insecticide-fungicide mixtures at the same time and to stick the chemicals on the seed by using the liquid fixation, spray, or slurry methods. There are now numerous slurry treaters in California which treat large quantities of corn, milo, cotton, beans, and other seeds. For sugar beets, where slurry treatment is not as efficient, spray treaters are used. Dusts are still applied commercially to cereals, and growers used dusts or liquid fixation by means of rotating barrels, cement mixers, or other available equipment.

Results to Expect

The proper dosage of lindane on seeds should result in adequate protection from wireworms and the seed-corn maggot. Seed treatment is usually not effective in controlling the garden centipede or cutworms. For wireworm control better results are obtained with those seeds in which the old seed balls or the seed coats remain in the soil. Wireworms contacting these seed parts are often affected for several weeks following planting. The suggested rates usually affect or kill 75% to 95% of the wireworms coming into the seed zone. Control is better with larger seeds such as beans, corn, wheat, and other cereals that are normally attractive to wireworms. Control may not be as good with certain small, less attractive seeds such as lettuce, carrots, alfalfa, and sudan grass. Inasmuch as seed-corn maggot attack takes place primarily at the time the seed is swelling and germinating, excellent control is usually possible—particularly on larger seeds such as beans.

As with any other chemical control measure there are occasional circumstances where seed treatments with lindane are not completely effective. Factors contributing to these failures are numerous, but a few of the more important factors are failure of wireworms to be active at the time of germination; extremely high populations, particularly of the seed-corn maggot; failure to apply an adequate dosage of insecticide; and failure to include a proper fungicide at the correct dosage. Recent tests indicate that damage to large lima beans formerly thought to be due to lindane is actually due to an increase of seed decay so that seedlings fail to emerge. This condition is corrected by the use of an adequate fungicide.

Suggested Rates

The suggested rates of lindane to use with a fungicide on different seed types are given in the table on the next page. Fungicides that can be safely combined with lindane are thiram—such as Arasan, or Thiram Naugets—chloranil—such as Spergon, Ceresan M, Phygon, Semesan—captan—such as Orthocide 75, 406, or Captan 50—and yellow cuprous oxide. Some proprietary combination products including lindane and captan, lindane and thiram, and lindane and chloranil are available.

Rates in the accompanying table are based upon studies that determined the most effective dosage giving adequate protection without damaging the seeds. Fordhook lima beans for example are one of the most sensitive seeds to lindane injury, whereas sugar beets are one of the most tolerant. The dosage rate also takes into account other factors such as the selectivity of seeds by wireworms, amounts of seed planted per acre, and the nature of the seed coats of different seeds.

Growers and others should use the chart as a guide only realizing that the rates are subject to change as new information is developed.

The amounts of 75% lindane to use for slurry treatment are given for the two methods of mixing ordinarily used. The first method is calculated on a basis of a total volume of one gallon of slurry. In this case the material is added to sufficient water to bring the total volume to one gallon. The second method is calculated on a basis of insecticide added to one gallon of water. This increased volume treats a larger amount of seed making it necessary to slightly increase the amount of insecticide used.

Other Insecticides

Experimental plots of several years duration and commercial treatments of thousands of pounds of seed of many different types indicate that lindane is the best insecticide for seed treatment where wireworms and seed-corn maggots occur in the same areas. When seed-corn maggot is the primary problem as occurs on lima beans in certain areas, then several other chemicals have given better control than lindane under high population levels. These chemicals include dieldrin and aldrin at the rate of one ounce of 50% material per 100 pounds of seed, and EPN-300— ethyl p-nitrophenyl thionobenzenephosphonate—27%, and heptachlor 50% at two ounces per 100 pounds of beans. Of these materials, EPN-300 and heptachlor give the best control of wireworms in addition to maggot control. It is suggested that these new chemicals be used only on an experimental basis, and preferably with a fungicide. In addition, because they show more acute toxicity to warm-blooded animals than lindane they should be used with caution until the full hazards of treating seed with them are fully determined.

Continued on next page

SEED

Continued from preceding page

The use of ethyl or methyl cellulose stickers may be advantageous in sticking chemicals on seeds so that they do not come off so easily in later handling. To date, however, there is little indication that stickers increase insect control appreciably.

Cautions and Suggestions

Prolonged storage of treated seeds is not recommended as a number of factors may determine damage from chemical treatment and these have not been fully determined. There is no indication that a storage period up to three months adversely affects seeds. Seeds should be stored under conditions that are not damaging to seed viability, and in addition, the seed lot must be of high germination prior to treatment and storage. In a recent test, sugar beet seed treated with the suggested rate of lindane and Phygon did not show adverse effects after a two-year storage period. A one year storage period of seeds may reduce the insecticidal efficiency of lindane by about 50%.

Slurry treaters should be rubberized or so adapted so that no mechanical damage is imparted to certain seeds, such as large lima beans. The proper use of slurry machines has demonstrated no appreciable adverse effects.

The use of one-package proprietary combinations of insecticides and fungicides in some cases may not allow the use of the suggested rates of materials. In these instances it may not be possible to place enough insecticide on the seeds to obtain maximum insect control when high populations of insects occur.

Flavor difference tests have shown that lima beans treated with 1.33 ounces of 75% lindane per 100 pounds of seed, did not adversely affect the quality of the crop.

Seed treated with lindane or other chemicals should never be used as food for either human beings or for domestic animals.

Operators handling these chemicals should wear adequate respirators, should wash thoroughly with soap and water following exposure, and should change clothing daily.

W. H. Lange is Associate Professor of Entomology, University of California, Davis.

E. C. Carlson is Principal Laboratory Technician, Entomology, University of California, Davis.

L. D. Leach is Professor of Plant Pathology, University of California, Davis.

The above progress report is based on Research Project No. 1275.

The flavor difference tests were conducted by Dr. Elly Hinreiner, Food Technology Department, University of California, Davis.

Suggested Dosage of Lindane for Treatment of Seeds for Wireworm and Seed-corn Maggot Control

Seed	Ounces of lindane per 100 lbs. of seed[1]			Amount of 75% lindane for slurry treatments[2]		Pounds of seed treated by slurry method			Amount actual lindane per acre (ounces)[5]
	100% actual material	25% dry dust	75% spray or slurry	Per gallon slurry[3]	Per gallon water[4]	Per gallon slurry	Per gallon water plus product	Per pound of 75% lindane	
				pounds-ounces	pounds-ounces				
Sugar beets[6]	4.0	16.0	5.33	2–12	3–3	823	951	300	0.32
Tomato	2.0	8.0	2.66	2–12	3–3	1646	1903	602	0.01
Cotton	2.0	8.0	2.66	2–12	3–3	1646	1903	602	0.50
Corn	1.0	4.0	1.33	1–6	1–8	1646	1774	1203	0.12
Peas	1.0	4.0	1.33	1–6	1–8	1646	1774	1203	1.00
Okra	1.0	4.0	1.33	1–6	1–8	1646	1774	1203	0.08
Cucumbers	1.0	4.0	1.33	1–6	1–8	1646	1774	1203	0.04
Cantaloupes	1.0	4.0	1.33	1–6	1–8	1646	1774	1203	0.04
Watermelon	1.0	4.0	1.33	1–6	1–8	1646	1774	1203	0.04
Lettuce	1.0	4.0	1.33	1–6	1–8	1646	1774	1203	0.02
Carrot	1.0	4.0	1.33	1–6	1–8	1646	1774	1203	0.03
Barley	1.0	4.0	1.33	1–6	1–8	1646	1774	1203	1.00
Milo	1.0	4.0	1.33	1–6	1–8	1646	1774	1203	0.05
Sunflower	1.0	4.0	1.33	1–6	1–8	1646	1774	1203	0.07
Onion	1.0	4.0	1.33	1–6	1–8	1646	1774	1203	0.04
Spinach	1.0	4.0	1.33	1–6	1–8	1646	1774	1203	0.08
Pepper	1.0	4.0	1.33	1–6	1–8	1646	1774	1203	0.05
Beans (baby limas)	0.5	2.0	0.66	0–10.9	0–11.3	1646	1710	2424	0.28
Beans (pole and dry)	0.5	2.0	0.66	0–10.9	0–11.3	1646	1710	2424	0.30
Oats	0.5	2.0	0.66	0–10.9	0–11.3	1646	1710	2424	0.45
Sudan grass	0.5	2.0	0.66	0–10.9	0–11.3	1646	1710	2424	0.08
Rye	0.5	2.0	0.66	0–10.9	0–11.3	1646	1710	2424	0.50
Safflower	0.5	2.0	0.66	0–10.9	0–11.3	1646	1710	2424	0.20
Alfalfa	0.5	2.0	0.66	0–10.9	0–11.3	1646	1710	2424	0.08
Ladino clover	0.5	2.0	0.66	0–10.9	0–11.3	1646	1710	2424	0.04
Soy bean	0.5	2.0	0.66	0–10.9	0–11.3	1646	1710	2424	0.15
Radish	0.5	2.0	0.66	0–10.9	0–11.3	1646	1710	2424	0.05
Cabbage	0.5	2.0	0.66	0–10.9	0–11.3	1646	1710	2424	0.01
Beans (large limas)	0.25	1.0	0.33	0–5.4	0–5.5	1646	1678	4849	0.30
Wheat	0.25	1.0	0.33	0–5.4	0–5.5	1646	1678	4849	0.25

[1] Lindane should be used with an adequate fungicide in most instances.

[2] Rates refer only to a 23 ml cup and a 10-pound pocket weight.

[3] One pound of 75% lindane displaces about 215-ml of water. To bring up to one gallon total volume add 1 pound of 75% lindane to 3569.6 ml. (or 7 pints); correct for other dosages.

[4] Dosage corrected for increase in volume when lindane is added to one gallon of water.

[5] Calculated for the usual planting rates of the different seeds.

[6] Rates for sugar beets refer to use of a 46 ml. bucket, as at a 10-pound pocket weight a larger volume of insecticide is needed.