



CONTROL OF INSECTS IN STORED GRAIN

The food and feeding qualities of Canadian grains, an important factor in our war time economy, should be well safeguarded.

The presence of insects or mites in stored grain reduces its value, and when they are numerous their feeding activities may cause the grain to heat.

Control Suggestions

Buildings and containers in which grain is stored should be cleaned thoroughly at least twice each year, and more often when practicable. All grain refuse should be destroyed by burning. In conjunction with such cleaning, spray liberally with pyrethrum-kerosene spray (see page 4) to destroy insect stages that may survive the cleaning process. This work preferably should be done in summer when grain stocks are usually low and the insects are most active. As soon as the bins are emptied give them a thorough cleaning.

Remember that infested grain screenings are a source of danger. If infested grain is sold to the elevators do not bring back the screenings.

Grain insects become inactive at temperatures below 45° F. In most parts of Canada the temperature during the winter is sufficiently low to prevent much insect development in unheated storage. Grain that is damp or heavily infested, however, may maintain temperatures favourable to insects in spite of prevailing low outside temperature conditions.

Where the grain bin is on the ground floor special attention should be given to the floor of the bin. If there are cracks and holes in it, the grain can pass through and afford the insects a place in which to breed, and in most cases the space beneath the bin is difficult or impossible to clean. The floors should be tightly sealed to avoid this trouble.

Moving or turning infested grain cools it and retards insect activity. When carried out in cold weather it results in the death of large numbers of insects. Sub-zero temperatures are specially effective. Passing the grain through a fanning mill removes many insects; when this is done, the insects thus collected should be destroyed by burning.

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Fumigation

In cases of severe infestation, fumigation may be necessary. In general, more successful results are secured with fumigants when the temperature of the grain is 70° F. or higher. This is due to more rapid vaporization and the greater activity of the insects at higher temperatures. When fumigation is attempted at lower temperatures the dosages must be materially increased.

The building or receptacle in which the treatment is to be carried out must be made reasonably gas-tight. All practical measures that serve to retard or prevent the escape of the fumigant should be put into effect. It is very desirable to build up a high concentration of the gas as soon as possible as this renders the treatment much more effective. Time spent in rendering the bins, or other containers, gas-tight is very much worth while. The duration of the fumigation also has a marked effect on the success of the treatment. In all cases this should be for at least 24 hours and preferably 48 hours.

It is best to choose a clear calm day for fumigation. Strong winds usually increase the leakage from the building and poorer results are obtained.

Preparation of Bins for Fumigation

From the point of view of fumigation, many farmers' granaries and storage bins are very poorly constructed, and require considerable work to render them satisfactory in this respect. In the future, farmers and others should consider fumigation needs when planning new storage facilities. New bins should be constructed with tongue and groove or ship lap joints, over one or more layers of heavy paper.

Available bins and other receptacles used in fumigation should be made as gas-tight as possible by pasting paper strips over all cracks and other openings, and by covering the bottom and sides with one or more thicknesses of heavy paper lapped at the seams and tacked firmly in place.

Method of Application

Most of the grain fumigants in common use are heavier than air and penetrate downwards. The liquid fumigant may be applied by sprinkling it quickly and evenly over the surface of the grain. The latter should then be carefully covered at once with a tarpaulin or other covering to retain the fumes. The fumigation should be allowed to continue for at least 24 hours and preferably 48 hours. If the grain is more than 4 or 5 feet deep it may be necessary to use a hollow pointed probe with perforations along the tube in conjunction with a funnel, to introduce the liquid fumigant below the grain surface.

Small lots of grain may conveniently be treated in an ordinary coal-oil barrel which will hold about five bushels of grain. In using either the carbon bisulphide or ethylene dichloride mixtures, $3\frac{1}{2}$ to 4 ounces of the liquid should be used for each barrel of grain. After applying the fumigant care should be taken to close the top of the barrel tightly. This may be done with a cap made especially for the purpose, or with fine sacks laid smoothly on the top and held down closely with weighted boards. The highly inflammable nature of carbon bisulphide is discussed elsewhere in this pamphlet.

The More Common Grain Fumigants

Hydrocyanic Acid Gas

This gas is widely used in certain kinds of fumigation work. *It is extremely poisonous to humans and animals* and should be used only by experienced fumigators working in accordance with any provincial or municipal regulations

that may be in force governing the use of hydrocyanic acid or cyanide compounds. Apart from the extremely poisonous character of hydrocyanic acid gas, best results can be secured from it only by thoroughly mixing it with the grain. This is possible in elevators where it may be fed into the grain stream just before it enters the bin. In the case of grain in farmers' bins, however, other materials are much more easily handled.

Chloropicrin

This material is a lachrymatory or tear gas. It is very deadly to insects, is non-inflammable, and small traces of it furnish positive warning of its presence to humans. The gas does not disperse readily, but clings tenaciously to fumigated goods, necessitating much aeration. Operators usually need to wear gas masks when fumigating with it. Two pounds of chloropicrin to 1,000 cubic feet of space is the dosage required to fumigate bins and tanks.

Ethylene Dichloride—Carbon Tetrachloride Mixture

This is an excellent grain fumigant. It consists of a mixture of 3 parts of ethylene dichloride and 1 part of carbon tetrachloride and is available already prepared. This mixture evaporates rather slowly. It may either be sprinkled over the grain or applied by soaking sacks in the liquid and laying them on the piles of grain. Best results are obtained at temperatures between 80 and 85° F. and its use below 70° F. is not recommended. The dosage recommended under satisfactory conditions is 3 pounds of fumigant to 50 bushels of grain. The treatment should be allowed to proceed for at least 24 hours. It is effective, simple to use, free from fire hazard, and not dangerous to human beings. It has an anæsthetic action, if much is inhaled, accompanied by a feeling of giddiness. If this happens the user should go into the open air at once.

Carbon Bisulphide

Carbon bisulphide is a colourless liquid, which on exposure to air vaporizes into a foul-smelling, highly inflammable, poisonous gas. Owing to its highly inflammable nature and the fact that it forms an explosive mixture with air, its use alone is not recommended. Ordinarily its use voids fire insurance policies.

There are now on the market proprietary mixtures of carbon bisulphide with other chemicals, such as carbon tetrachloride and sulphur dioxide, which reduce the fire hazard. Although not absolutely non-inflammable, these mixtures are sufficiently safe to have the approval of fire underwriters. The efficacy of the mixtures is directly proportional to the percentage of carbon bisulphide they contain.

A mixture of carbon bisulphide, carbon tetrachloride and sulphur dioxide is used rather commonly. It is most effective when used at a temperature of 70° F. or higher, but good results have also been secured when the grain temperature has been as low as 50° F. Under such circumstances it is necessary to increase the dosage as the insects are more resistant to the fumigant at lower temperatures.

Under normal circumstances, where the container is reasonably gas-tight, a dosage of about 2 gallons of the liquid per 1,000 bushels of grain gives satisfactory results in treating small lots. As the quantity of grain increases, and where a tight receptacle such as a steel tank or concrete bin is used, the dosage may be reduced.

Contact Sprays

Many insects may be killed by the use of contact sprays. Numerous commercial sprays consist of pyrethrum extract in a mineral oil more or less similar to kerosene, others contain aliphatic thiocyanates in place of the

pyrethrum. As the name suggests, the insects must actually be hit by the spray to be killed. This method of treatment is quite valuable when the insects are present on the walls of bins and similar places, and are otherwise accessible to the spray. The spray operates most satisfactorily in a confined space and best results are secured when doors and windows are closed. The dead and paralysed insects should be swept up to prevent any from recovering.

A very useful spray may be prepared by those who prefer to make their own from pyrethrum insect powder and kerosene. This is made by adding one pound of *fresh* pyrethrum insect powder to one gallon of kerosene (coal-oil) allowing the mixture to stand and agitating it at intervals over a period of about 2 hours, thus ensuring that practically all the active principles of the pyrethrum are dissolved. The residue of the pyrethrum settles to the bottom of the vessel as a brown sediment, and the clear lemon-yellow liquid may be siphoned or filtered off. The spray should be kept in a tightly corked metal container to prevent deterioration.

Protection of Seed Grain

Copper carbonate dust, which is used against disease spores on seed wheat, also prevents insect damage. Grain so treated may be held over safely until the following season. The usual treatment is two ounces of copper carbonate per bushel of wheat. Grain so treated, should *not* be used for animal or human consumption.

Seed corn may be protected from insect attack by dipping the ears in oil emulsions and miscible oils such as are used for spraying fruit trees. The emulsions are diluted at the rate of 1 part emulsion to 10 parts of water.

In cases where the insects causing the damage are not recognized, specimens should be sent to the

Dominion Entomologist,
Department of Agriculture,
Ottawa, Ont.

in a tightly closed container. A letter giving details of the trouble should accompany the specimens. This will enable a prompt and complete reply to be made with instructions as to the best methods of control.

Insect Species

Several species of insects may infest stored grain. Among the more injurious are the granary and rice weevils, *Sitophilus granarius* L. and *S. oryzae* L. Other species, several of which are important and injurious, especially in broken grain and coarse grain products, are the saw-toothed grain beetle, *Oryzophilus surinamensis* L., the confused and rust-red flour beetles, *Tribolium confusum* Duv., and *T. castaneum* Herbst., the flat grain beetle, *Lamaphlæus minutus*, Oliv., the rust-red grain beetle, *L. ferrugineus* Steph., the foreign grain beetle, *Ahasverus advena* Walzl., the cadelle, *Tenebroides mauritanicus* L., the yellow and dark mealworms, *Tenebrio molitor* L. and *T. obscurus* Fab., book lice or psocids, and mites,

Prepared by H. E. GRAY,

Division of Entomology, Science Service, Department of Agriculture, Ottawa.