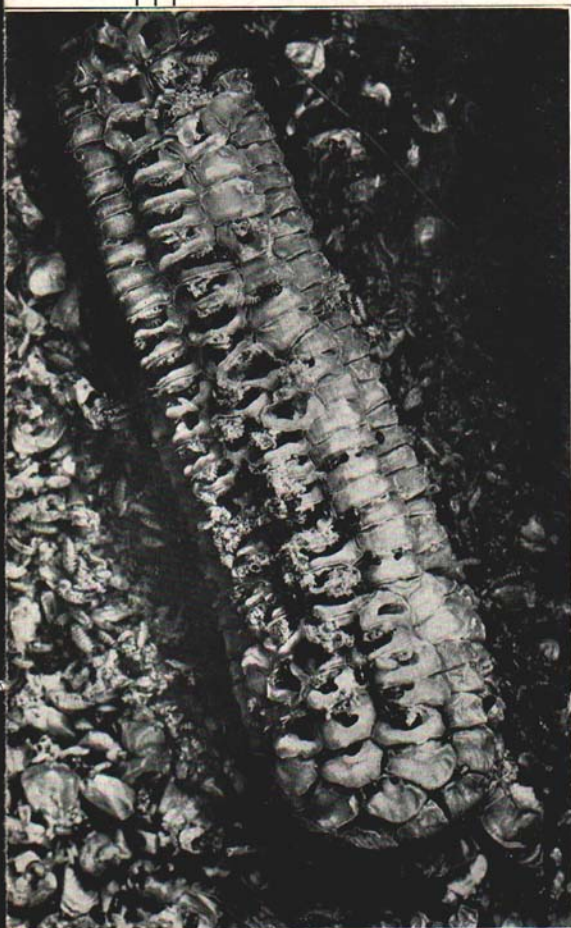


# INSECTS ATTACKING STORED FOODS

## *and* CEREAL PRODUCTS

*By E. I. McDaniel*



**MICHIGAN STATE  
COLLEGE**

**EXTENSION  
DIVISION**

**EAST LANSING**

**Sweet Corn Being  
Destroyed by  
Carpet Beetle  
Larvae**

Michigan State College of Agriculture and Applied Science and U. S. Dept. of Agriculture cooperating. R. J. BALDWIN, DIRECTOR EXTENSION DIVISION, Michigan State College, East Lansing. Printed and distributed under acts of Congress, May 8 and June 30, 1914.

## FOREWORD

Insects have been recognized as a hazard in the storage of cereals and their products since time immemorial. As a consequence methods for controlling them in elevators and other places where large quantities of cereals are stored have been worked out.

However, in the household, small amounts of cereal products are commonly kept under conditions to which the control methods devised for larger quantities do not apply. The measures set forth in the bulletin have been worked out with this condition in mind.

## Insects Attacking Stored Foods and Cereal Products

E. I. McDANIEL

The universal distribution of insects attacking stored foods and cereal products, together with their cosmopolitan food habits, accounts for their occasional appearance even where scrupulous sanitary conditions obtain. Some species attack growing crops, and where infested material is stored under conditions conducive to insect development serious outbreaks often occur. Other species are restricted to harvested grain or finished food products. Infestation from this group of insects may occur anywhere along the line from the producer to the consumer.

Of the insects attacking stored foods and cereal products, beetles and moths predominate though there are several species of flies and a number of mites which occasionally present serious problems.

Among the beetles, the bean weevil (*Mylabris obtectus*), the pea weevil (*M. pisorum*) and the rice weevil (*Calandra oryzae*) infest grain in the field and continue their development in the stored seeds. Where infested rice or other grain is shipped to northern markets temporary outbreaks of the rice weevil often occur. The bean weevil confines its feeding to beans



Fig. 1. Eggs of bean weevil (enlarged 50 times) and adult bean weevils (enlarged 9 times).

and peas, although all varieties are attacked. Usually there are several larvae to a single seed and development continues in the dried seeds as readily as in soft seeds. There are from six to seven generations a year. Infested beans are unsuitable for food, and when planted they simply re-establish the infestation in the field. The adults vary considerably in size, usually measuring about one-eighth inch in length. There are several kinds of bean weevils, but all are similar in general habits and appearance. It is not unusual for adult bean weevils to emerge during late winter or early spring from infested seeds stored in a warm place. In the house the adult beetles often cause considerable concern since they are often found either



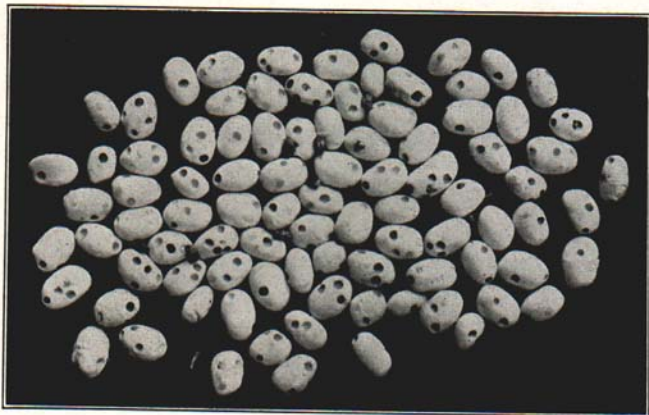


Fig. 2. Weevily beans.

scattered through the cupboards or pantries, or collect on the windows in an attempt to get out-of-doors. They are, however, harmless to everything except beans and peas.

The pea weevil differs from the bean weevil in that there is but one generation a year, and but one larva develops in a seed. Pea weevil attacks peas only. The adult is slightly larger than the bean weevil usually measuring about one-fifth of an inch in length.

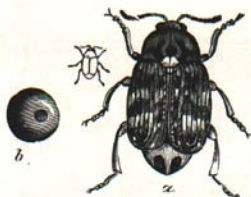


Fig. 3. *Mylabris pisorum*: a, adult, enlarged and about natural size; b, pea, showing work of beetle. Enlarged. (U. S. D. A. Chittenden.)

The rice weevil is primarily a grain pest, although the adults are occasionally found in flour and meal. In the south, the adult lays her eggs on ripening grain in the field. There are several generations each year, six or seven weeks being required to complete a life-cycle. The adults are dark brown beetles measuring about one-sixth inch in length. Their wing covers are ornamented with four light patches.

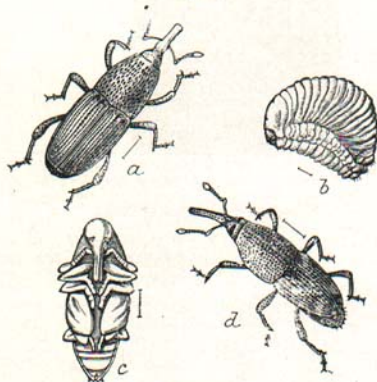


Fig. 4. *Calandra granaria*: a, beetle; b, larva; c, pupa; d, *C. oryza*, beetle. Enlarged. (U. S. D. A. Chittenden.)

The confused flour beetle (*Tribolium confusum*), the saw-toothed grain beetle (*Oryzaephilus surinamensis*), the drug-store beetle (*Sitodrepa panicea*), the cigarette beetle (*Lasioderma serricorne*), the white-marked spider beetle (*Ptinus fur*), the granary weevil (*Calandra granaria*), and black carpet beetle (*Attagenus piceus*) usually attack stored foods or finished cereal products.

The confused flour beetle is found everywhere, and attacks a wide range of foodstuffs including all kinds of grain and milled products of a starchy nature. It has also been taken in baking powder, ginger, orris root, drugs, snuff, cayenne pepper, beans, and peas. Apparently the adult is not capable of maintaining itself in sound grain, and though found in granaries and warehouses, it feeds only on injured grain or milled products. It is particularly a pest in mills, cereal factories, grocery stores and homes. There are several generations a year under normal conditions. The adult is a reddish brown beetle about one-seventh inch long.

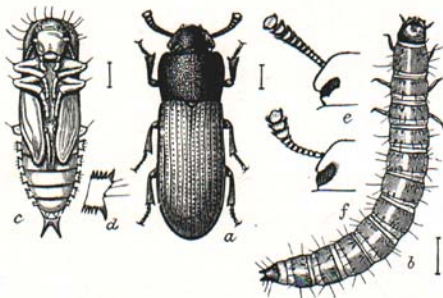


Fig. 5. *Tribolium confusum*: a, beetle; b, larva; c, pupa; d, lateral lobe of abdomen of pupa; e, head of beetle, showing antenna; f, *T. ferrugineum* head, showing antenna. Enlarged. (U. S. D. A. Chittenden.)

The saw-toothed grain beetle is primarily a pest of prepared foods rather than of stored grains. It is capable of maintaining itself in wet grain, but

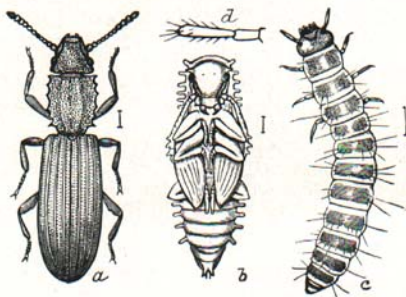


Fig. 6. *Oryzaephilus surinamensis*: a, adult beetle; b, pupa; c, larva; d, antenna. Enlarged. (U. S. D. A. Chittenden.)

is more commonly found in breakfast foods, flour, macaroni, cornstarch, baking powder, dried meats or fruits, nuts, sugar, yeast, candy, spice, ginger, mustard, snuff and tobacco. It is not unusual for the adult to chew its way through paper containers. The beetle breeds rapidly—it is possible for a generation to develop in 30 days. The adult is a flat, slender brownish-red beetle about one-tenth inch long.

The cadelle occasionally becomes a household pest. It confines its attack to the products of stored grains rather than to the grain itself, and if short of food it may develop cannibalistic tendencies, feeding on the weaker members of its own brood, or upon other, stored grain insects. Where compelled to feed on whole seed, it consumes



the germ, leaving the rest of the seed uninjured. Where the larvae do infest packaged stored food products, they are particularly objectionable because they cut holes in paper sacks and cartons. When ready to pupate the larvae may excavate shallow cavities in the wood where they transform to adults. The mature larvae measure about three-fourths inch in length. Their bodies are soft, dirty-white with black heads. The adults are shiny black beetles with obvious constriction just in front of the base of the wings. It requires a year to complete its cycle, though the adults may live for a year or more. Where storage houses are cleaned two or three times a year this beetle will not become a pest.

Mealworms are occasional pests in houses though they usually develop in waste grain rather than processed grain. They prefer dark, damp, out-of-the-way places and thrive in wet, moldy material. A year is required to complete a generation; the adults appear in the spring and deposit their eggs. The larvae are yellow worms with firm bodies, somewhat resembling wireworms in appearance. When the larvae complete their development, they come to the surface and the unprotected white pupae are exposed. The adult beetles are black, unstricted, and vary in size from one-half inch to an inch or more in length.

The drug-store beetle feeds on practically all dried plant and animal products. About two months are required to complete a life-cycle. The reddish-brown beetles measure about one-tenth inch in length and the body is thickly covered with short hairs; the wing covers are grooved or striated. The last three joints of the antennae are enlarged. The larvae are practically naked resembling tiny grubs. Pupation takes place in the larval burrow or in particles of food fastened together.

The cigarette beetle not only attacks tobacco and food products but may become a furniture pest in sections of the country where tow is used for filler in upholstered furniture in place of hair, wool or feathers. The adult, when ready to emerge, cuts holes through the upholstery. The beetle is versatile in its food habits and has been taken from more than 100 different drugs, foodstuffs, and processing material. The adults are reddish-brown beetles measuring about one-sixteenth inch in length and are clothed with fine hairs. The antennae are uniform in size. The larvae are densely clothed with long uneven hairs.



Fig. 7. Larder beetle.

The larder beetle confines its food to dried animal matter. Spoiled meat or dead animals are the common sources of food for the larvae. The adults feed on pollen. The beetles vary in size from one-fourth to one-third of an inch in length. They are dark brown with a conspicuous band of dingy white at the bases of the wing-covers. The larvae are brown, covered with long hairs of irregular length. The body tapers at either end and the caudal end is ornamented with a pair of forceps-like clasps. Cured meat kept in cold storage is safe from the attacks of this beetle. Sack all exposed cured meat, either in muslin bags, or wrap in paper to prevent the beetles gaining access to lay their eggs. Trim off and dispose of any infested portions of cured meat where only slight injury occurs. To prevent the beetles increasing in numbers, destroy all infested meats, or dead animals.

The spider beetles sometimes appear in houses where they not only feed on cereal products but are also destructive to books and clothing. There is one generation a year. The adult is a dark brown beetle spotted with white. It measures about one-eighth inch in length. The long legs and antennae together with the peculiarly constricted body gives the creature a spider-like appearance. The soft white grubs usually feed within cells made by cementing together particles of food.

The granary weevil confines its attacks to stored grains. The mother beetle excavates an opening in the kernel and deposits her egg in the cavity

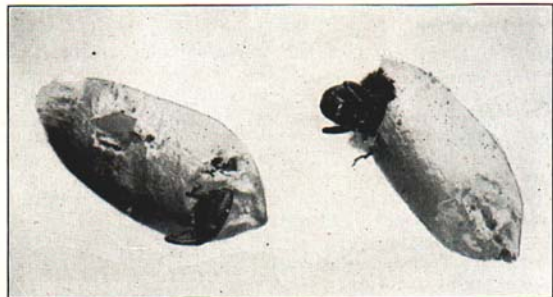


Fig. 8. Granary weevil in wheat.

and the legless grub completes its development inside the kernel. The beetles are often found in flour but they do not reproduce young except where they have access to whole grain. The adults are uniform reddish-brown in color.

The black carpet beetle not only attacks and destroys clothing, rugs and furniture, but it often becomes a cereal pest. Floor wax, garden seeds, cereal products and dried milk all are recorded as being attacked. In mills and factory it does the most damage where it makes large irregular holes in the bolting cloth. The species breeds slowly. About two years are required to complete a life-cycle. The elliptical black beetle measures about one-eighth of an inch in length. The larvae differ from those of other species in that they have long brush-like tails made up of numerous hairs.



Fig. 9. Black carpet beetle; adult and larva. (U. S. D. A.)

A number of different species of moths are known to attack stored foods and cereal products, of these four species are of particular economic impor-



tance in Michigan—the Indian meal moth (*Plodia interpunctella*), the Mediterranean flour moth (*Ephestia kuehniella*), the meal snout moth (*Pyralis farinalis*), and the Angoumois grain moth (*Sitotroga cerealella*).

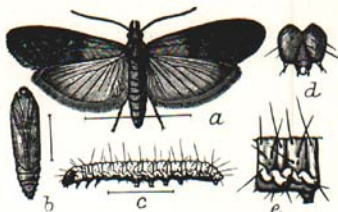


Fig. 10. *Plodia interpunctella*: a, moth; b, chrysalis; c, caterpillar; d, head; e, first abdominal segment of caterpillar. Enlarged. (U. S. D. A. Chittenden.)

three-fourths of an inch and measure when at rest, fold close to the body.

The larvae measure about one-half inch in length, and vary in color from dull white to a white with a delicate greenish tinge. Once established in a house, the Indian meal worm is difficult to eliminate, and only the most thorough clean-up campaign will be effective.

The Mediterranean flour moth often infests flour, bran, meal or other finished products, though it is capable of maintaining itself on whole grain. The larvae spin a quantity of silk and have a habit of webbing their food together in large irregular masses. It is important in flour mills where it causes the flour to mat and clog up the machinery. The moths are pale brownish-grey with the wing covers marked with two irregular, broken, black zig-zagged lines; the wing expanse is something over one-half inch. The adult moth has a curious habit of elevating the fore-part of the body when at rest. The larvae measure from one-half to five-eighths inch in length and are creamy white, or with a decidedly pinkish tinge and are usually to be found in silken tubes. Eight or ten weeks are required to complete a generation.

The meal snout moth is an occasional household pest though it is usually found in damp, dark granaries or storage houses where bran and meal are allowed to collect undisturbed. The adults have a wing expanse of about three-fourths inch. The fore-wings are strikingly marked with chocolate-brown at the bases and at the tips, with a dusky band of greyish-white edged with white through the middle. When at rest or when disturbed, this

Of these the Indian meal moth is perhaps the greatest problem in grocery stores and pantries. It feeds on a wide range of food products including cereal products, dried fruits, nuts, herbs, spices and at times it is troublesome in candy stores where it breeds in nut meats. The life-cycle is short, only from four to six weeks being required to complete a generation. They increase rapidly; each female depositing something over 300 eggs in the course of her life time. The moth has a wing expanse of about one-half inch long. The wings, The front wings are greyish-white at



Fig. 11. *Ephestia kuehniella*: a, moth; b, side view of moth; c, larva; d, pupa; e, abdominal segments of larva. (U. S. D. A. Chittenden.)



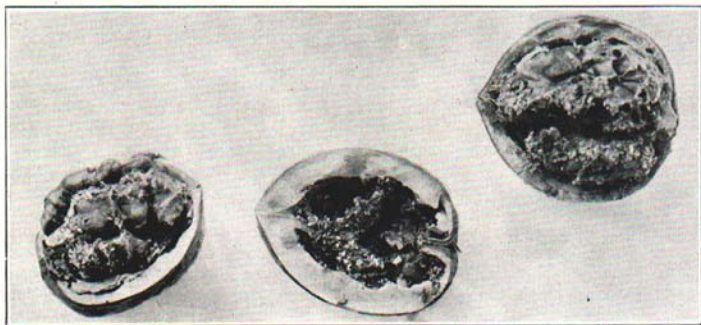


Fig. 12. Work of Indian meal moth in English walnuts.

moth elevates the tip of the abdomen over the back. The larvae, when mature, measure about an inch in length. They are greyish-white with dark-brown heads. Like those of the Mediterranean moth, they have the habit of webbing their food material together with silk. This species can most readily be exterminated by eliminating the source of the infestation.

The Angoumois grain moth is capable of being destructive to grain in storage and may occasionally become a household pest. It shows a decided preference for whole grain and at times is a problem in various kinds of seeds in storage. In the South, where this moth is more numerous than in the North, it often attacks grain in the field.



Fig. 13. *Pyralis farinalis*: a, adult moth; b, larva; c, pupa in cocoon. (U. S. D. A. Chittenden.)

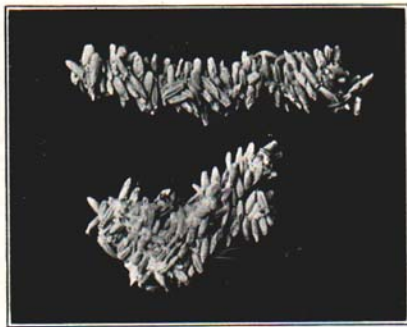


Fig. 14. Wheat webbed together by larvae of meal snout moth.

The adults are small, buff-colored moths, with a wing expanse of about one-half inch and ornamented along the edges with a fringe of long hairs. The mature larvae measure about one-fifth of an inch in length and are white with yellowish heads. They have a habit of curling up in the grain or seed and are seldom found at large. In the northern seed storages or houses there may be as many as five or six generations a year.

## CHEESE SKIPPER

The cheese skipper (*Piophilidae casei*) is world-wide in its distribution and may develop into a serious local pest, particularly in the vicinity of packing houses, grocery stores, or the home pantry. Its food is apparently restricted to animal fats. It prefers pork to beef. Where the infested portions of meat are trimmed off the remainder is unharmed for human consumption since putrefaction does not follow the work of this maggot. Where cheese is attacked, rich cream cheese is the flies' first choice. Where once established, the cheese skipper will breed continuously in the animal fats which collect in cracks and crevices. The adults are small black flies about half the size of a housefly. They lay their eggs on the meat or on cheese and the maggots or skippers feed near the surface. When mature, the slender footless white maggots measure about one-third of an inch in length. They move about by forming an arc—drawing the head and tail together—then suddenly straightening out, this gives a jerky, skipping motion from which the maggot gets its common name. The larval stage is complete in from seven to 10 days and from three to five weeks are required to complete a life-cycle.

**Control**—Scrupulous cleanliness is essential to eliminate this insect. Clean cracks and crevices with hot lye water. Protect exposed cheese with a screen covering, using a 30-mesh screen. During the summer months store cheese at a temperature below 45° F.

## MITES

Several species of mites infest food material, of these the mites belonging to the genus *Tyroglyphus* predominate. They breed in practically all types of organic material and are transported from one place to another by rodents, insects and with infested material. The population increases rapidly and individuals are quite resistant to adverse conditions. Mature mites are capable of existing for some time without food, while in the immature stage certain individuals are capable of going into a resting stage which makes it possible for them to exist for months under adverse conditions. Mites breed in fertilizer, meat, cheese, sugar, ground feed, grains, cereal products, flour, drugs, dried fruits or roots and bulbs. Of the recognized species the following are the best known: The cheese mite (*Tyroglyphus longior*) infests cheese, meat and various animal by-products; the flour mite (*T. farinae*) attacks grain, flour and various other cereal products. *T. americana* has been recorded from wheat, rotting fruit, flaxseed, rice and cotton seed. The sugar mite (*Glyciphagus robustus*) sometimes becomes so abundant in grocery stores that it sets up a skin irritation known as "grocer's itch".

To clean up an infestation of mites, locate and remove the source of the infestation. A sulphur fumigation, using 3 to 4 pounds of sulphur to a thousand cubic feet of air space, is effective. Scrub infested shelves, cabinets or rooms with hot lye water, taking precautions to treat all cracks and crevices.

Aside from the insects discussed in this publication there are numerous other species with similar life histories and similar habits. They all respond



to practically the same control measures. The activity of most stored grain insects is slowed up when the temperature drops to 40° or 50° F. It is, therefore, advisable where possible to store susceptible foodstuffs at 40° F. or below where possible. On the other hand where the temperature can be raised to and maintained at 125° or 130° F. (still heat) for sufficient period to insure penetration all insect life will be killed. From half to three-quarters of an hour "still heat" at the prescribed degree is sufficient to kill all stages of insect life, but where bulk of material is to be treated it must be maintained for from six to twelve hours to insure complete penetration. Heat treatment is safe for most garden seed where the temperature does not go above 130° F. Where flour is treated at or above 174° F. the "rising" properties are affected. A certain amount of moisture is necessary for insect development. They apparently thrive best when the humidity is about 70 per cent.

In the home where the source of infestation is an old fashioned kitchen cabinet or built-in flour bin it will be necessary to remove all flour from around the flour bin, since here is where cereal insects of all kinds and in all stages of development collect, and here generation after generation of insects may breed. Scrub the bin thoroughly inside and out with hot lye water, since tiny eggs or larvae may be tucked away in cracks and crevices.

Ordinary fumigation does not as a rule give satisfactory control since sufficient penetration is not obtained where fumigation seems imperative. Either carbon tetrachloride or propylene dichloride mixture are suggested. Either will give a good kill, and no fire hazard is incurred. The temperature should be 70° F. or above and the bin, room or container, should be as nearly air-tight as possible. Leave the place closed for 48 hours before opening, then air out thoroughly. Both chemicals are sold as liquids and since the fumes of either are heavier than air the liquid should be placed above the material to be fumigated. Use carbon tetrachloride at the rate of 3 pounds to each 100 cubic feet of air space and use propylene dichloride at the rate of 2 pounds to each 100 cubic feet of air space. In either instance the fumigant will be more effective if the liquid is volatilized rapidly. Where hot irons are dropped in the container just before closing the fumigation chamber, or where it is possible to use an electric plate to volatilize the liquid the results will be correspondingly more satisfactory.

Sulphur fumigation occasionally seems advisable. Where 3 to 4 pounds of sulphur to each 1,000 cubic feet of air space are burned in an air-tight room practically all insects will be killed. The use of sulphur always incurs a certain fire hazard. The fumes tarnish metal, affect the coloring in wall paper and there is some deterioration in fabrics. Also any shrubbery close to the house may be injured by the fumes as they seep out.

Small quantities of seeds may be protected from insect attack by packing in air-slaked lime; for small quantities ( $\frac{1}{2}$  peck) use 4 parts lime to 1 part seeds, in quantities between  $\frac{1}{2}$  peck and 2 or 3 bushels (use equal parts air-slaked lime and seeds).



### CONTROL

1. Dispose of or treat all infested stock.
2. Reduce the stock on the shelves to the minimum.
3. Store all susceptible foodstuffs in tight tin or glass containers.
4. Keep susceptible food supplies in a cool (40° to 50° F. or below) dry place.
5. Heat treatment, in bulk (130° F. for 6 to 12 hours), for small lots (15 or 30 minutes in an oven).
6. Scrub all cracks and crevices thoroughly with hot lye water.
7. The temperature should be 70° F. or higher for fumigation to be effective.
8. Fumigate with carbon tetrachloride (3 pounds per 100 cubic feet); propylene dichloride mixture (2 pounds per 100 cubic feet or 2 tablespoons per bushel of grain); sulphur (3 or 4 pounds per 1,000 cubic feet); hydrocyanic acid fumigation, applied by a professional, is also suggested.
9. Pack seeds in air-slaked lime ( $\frac{1}{2}$  peck in 4 parts lime to 1 part seeds). Over  $\frac{1}{2}$  peck up to 2 or 3 bushels use equal parts air-slaked lime and seed.