CURRENT SCIENCE

Vol. XII] MAY 1943 [No. 5

STORAGE OF FOOD GRAINS

THE recent establishment of a separate department of food, with a budget of twenty crores of rupees, by the Central Government has been part of a vast network of developmental activities in India, as in other allied countries, inaugurated to meet the complex and emergency conditions created by the War. It bears ample testimony to the realisation of the tremendous importance of food supply in a country of such vastness, variety and distances as India. The large body of the defence personnel and the huge civilian population in the country, both together, demand an extremely wide and well-organised and efficient system of adequate food supply. At a time when war has come to the very doorsteps of the citizens, and when, practically, every one, from the office clerk to the munition factory worker, is engaged in war effort, and when high civilian morale is considered to be as important as the morale of the fighting forces, the question of an adequate supply and equitable distribution of food necessarily assumes infinite importance.

Nor is the matter of proper storage of food grains and other products meant for consumption any less important at a time like the present. Few people realise that the State and its citizens, as well as the fighting forces, have to contend with quite a vicous and powerful army of sabotaeurs, where preservation of food grains is concerned. It is estimated that the direct and indirect loss sustained every year in India in the sphere of staple food commodities before and after harvest on account of the destructive activities of a variety of insects alone, easily mounts up to two thousand crores of rupees; and a fair proportion of this loss has been attributed to the havoc played by that special group of insects that infest food grains and other related products in storage. While, in normal times, the very inadequate or even entire lack of appreciation of this colossal destruction of vital food materials by insects could, perhaps, be somewhat excusable, in times of war, any such tendency on the part, even of the individual citizen, and the State in particular, would be utterly suicidal.

Directly, the insects excavate and feed on or otherwise destroy the vital contents of the grains, besides filling their cavities and the store in general, with their faeces and the dead; indirectly, as a result of their normal and vital life-processes of

respiration and metabolism, the internal atmosphere of the storage receptacles, etc., is rendered so excessively humid and warm as to cause the growth of harmful fungi and the starting of fermentation; the grains, being themselves alive and, in a state of active respiration, further complicate and worsen matters. Where insect-infested grains remain in storage for long periods the cumulative effect is rarely less than total devastation; for, even that portion of the food grains that escape the direct attentions of the insect populations, is ultimately rendered unfit for human consumption, having been so badly affected by the evil effects of fermentation.

Man was faced with the problem of securing a proper storage of his food grains, the moment he thought of harvesting and conserving his crops. Various methods of storage have since been in vogue in different parts of the world with the common object of preserving the grains from the destructive activities of certain kinds of predatory insects and mites which thrive and breed in food grains during storage. A review of the methods of grain storage practised over considerably long periods reveals that they are too few and circumscribed in character. But some of the age-old methods, though very simple and somewhat crude, are really very ingenious and suggestive and serve the purpose for which they are applied fairly well. Of comparatively recent introduction are other methods that tend towards much complexity and specialisation, and lie rather beyond the scope of the average agriculturist, the grain merchant or the housewife, especially in India; but they may be easily adapted to the special and emergent conditions brought about by the war, through the agency of the Central and the Provincial Governments in the country.

It should be extremely interesting and instructive to examine critically the several methods of storage of food grains already in vogue in this country. Practically all these are age-old and time-honoured methods, having their good as well as bad points. And, having regard to the economic conditions of the peoples of India, they appear to be almost ideal; but, it should be admitted that they are so, not from the point of view of efficiency but the standpoint of easy adoption and management; the desirability or the possibility of improving upon them, therefore, does exist.

It is difficult within the limits of this note to go through all the several methods pointing out in detail their merits and demerits and considering ways and means of improvement. A few of the more important ones could, however, be touched upon briefly. The earthen pots, bins and baskets made of bamboo, plaited straw and fibre, gunny bags and underground cellars of different shapes and sizes, used as containers for storing grains—cereals and pulses—and other forms of food materials in rural and urban parts of the country are all fairly well known to everyone. These containers would not have been accepted generation after generation, if they had not their very good points about them. The very shape of the pots and bins—with narrow necks (mouths kept sealed up) and wide and oblong or spherical bodies, some of them with small valve-like lateral outlets, somewhere towards the bottom, is admirably well suited for the purpose of preventing serious damage by insects. The tightly-packed grains inside leave little or no room for movement or other activities of the insects. The practice in some localities of mixing the grains with extraneous matter like sand, husk or ashes, further helps in blocking up interspaces between the grains. Bags and sacks made of gunny, plaited straw and fibre, and with tightly-packed grains to the brim and stacked one on top of another, usually prove fairly efficient in keeping insect damage to a minimum, as the great pressure thus exerted on the pile of bags, effects a further and closer packing of the medium, thereby reducing the moving space for the insects. Cement concrete cellars, above or underground, rendered perfectly air-tight and dry, with a tight fitting and carefully operated trap-door, also serve to an appreciable extent to keep away most of the insect pests. The practice of smearing the top layer of grains (pulses) with castor oil, when baskets and bins are employed for storage, has the particular advantage of preventing the successful hatching of the grubs and later, boring into the grains; the presence of the oil renders the hold on the grains necessary for excavating impossible. One of the most interesting methods of control practised in certain rural areas and now apparently

given up, consisted in the use of a small pellet of mercury in a shallow cup placed in a corner of the storage receptacle on the topmost layer of the grain. Mercury is sometimes used for preserving certain kinds of pickles safe from "worms". One of the most common preliminary treatments of the grain before storage practised even by the less advanced of village folk is the sun-drying of the grains spread in a thin layer for varied lengths of time; this has been found to constitute one of the most natural, simple and efficient methods of rendering the grains sufficiently dry for storage and of ridding them of the associated insects that might have been carried over into the grain from the field, the threshing grounds or during transit.

This brief review of some of the existing methods leaves one to wonder why, in actual practice, so much of damage and loss is still being caused by insects during storage. The reason lies in the circumstance that necessary attention to detail is not paid in the practice and application of the methods. Often, the methods are not described in sufficient detail and with adequate precision to bring the method under scientific control. Efforts to eliminate these defects to a large extent are being made and a few improvements have been effectively introduced and successfully demonstrated. But the indifference and the conservative attitude on the part of the people expected to adopt these methods, has continued. This is well illustrated by the fact that the recommendation based on the discovery that a top dressing of the mass of grain under storage with a two-inch layer of sand effectively prevents infestation, has not been generally adopted in spite of its obvious simplicity and proven efficiency.

There is, however, considerable scope for further research in the direction of evolving other simple, inexpensive and effective methods and in improving upon the old ones. A few such lines of work may, perhaps, be touched upon at this stage. While the shape of the bins and baskets used for storage all over the country and the constructional materials from which they are made are undoubtedly ideal for Indian conditions, specially in rural parts, the mixture of mud and dung used to smear the outer surface urgently requires to be substituted by some equally porous but far less vulnerable material, exhibiting little tendency to crack or peal off with age. Bamboo and fibre bins, which are highly susceptible to termite attack should be rendered termite-proof. The usual practice of keeping the receptacles elevated on stone and other kinds of supports does not always leave them immune from the attentions of this dangerous pest. The bags or sacks made of jute, fibre and plaited straw generally have a large surface exposed and invite insect invaders; this circumstance offers the possibility of employing some inexpensive, efficient and innocuous insecticide in the form of fine dusts or sprays to cover the exposed portion of the bags at regular intervals. This treatment will serve to repel or kill the invading insects. In the case of cellars or pits full with grains, our knowledge is very meagre with regard to the environmental conditions prevailing there. The effect of these conditions on the quality of the grain has not been carefully determined. The nature and extent of infestation in them more than in other methods of storage, largely depend upon the factors of temperature and humidity. A critical study of the interplay of these two factors inside them, though extremely difficult to conduct is, nevertheless, essential if grains stored therein for long periods, have to be preserved from insect damage and in a perfectly fit condition for human consumption and for seed propagation. The reputed property of mercury in preventing insect infestation needs to be carefully and scientifically examined. A certain amount of work has been carried out in India in recent years in this connection but unfortunately it did not progress sufficiently far. Not only the pure metal but even tin amalgam was found to have a decidedly deleterious effect, particularly on the eggs of certain species of insects infesting grains. While the how and why and numerous other details of the peculiar influence of mercury on insect eggs would, undoubtedly, form most fascinating lines of study, the investigation of the practical utility of the method applied on a large scale, is one that could be taken up with advantage.

The more modern and specialised methods of controlling the grain pests, recently evolved by research, may now be considered at some length. The practice of subjecting infested grains and other food

products to the action of poisonous fumes is prevalent in other countries, particularly in the United States of America. The practice of fumigation on a large scale being a highly technical process, is naturally entrusted to qualified chemical engineers and others specially trained for the purpose. Where food grains and other products meant for consumption are concerned, the method assumes special importance and special precautions become necessary. The rates of respiration and metabolism of the infesting insects have a direct bearing on the efficiency of fumigation. Attention should be paid to the residual fumigant whose quantity is likely to vary with different kinds of food materials, and to the most effective method by which the residue can be successfully eliminated or neutralised. It is generally recognised that fumigation is only rarely resorted to for purposes of ridding food-stuffs of insect infection even in countries outside India, because of lack of adequate knowledge with respect to the foodworthiness of the grains fumigated by hydrogen cyanide and carbon disulphide. It has been established that an auxiliary fumigant like carbon dioxide enhances the effect of the principal fumigant like hydrogen cyanide by causing the insects to keep open their spiracles or breathing apertures; but no attempts appear to have been made to examine whether carbon dioxide does not concomitantly help in the absorption of larger amounts of the fumigant by the food grains themselves, in which case the problem of residual fumigants becomes much more serious. In the present uncertain and unsatisfactory state of our knowledge, it would appear safer to concur with the view that, in the task of preserving food grains, simple and safe methods alone are to be recommended and adopted until, at least, the most correct form of fumigation practice is evolved and established to be perfectly safe from the consumers' point of view.

Other substances like methyl-bromide and "Chlorosol" (a mixture of ethylene dichloride and carbon tetrachloride) for example, have, of late, been widely recommended as decidedly safer and equally effective. It is high time that competent authorities under the auspices of the Department of Food took up a comprehensive investigation of the practicability of the use of these and other types of "Safe" fumigants. Under the stress of the existing emergent conditions in India, the need for storing large quantities of food grains in a large number of localities all over the country, has definitely arisen; the time is, therefore, ripe for planning and implementing.

Processes like dry-heating and cold-storage have been employed in prevention of insect infestation of food-stuffs. These physical control measures also deserve to be considered very seriously, in so far as they are perfectly "safe" for the consumer. No expense can be too high in the matter of setting up and operating the necessary heating plants and cold stores, at a time like the present.

If the country should reap the fullest benefit from the creation of the Department of Food with its princely budget, the functions assigned to the Department should include the task of advising and guiding the large body of private people, the grain merchant and the individual citizen, in the matter of combating insect enemies effectively. This task can be performed only by technically trained men. The best course to adopt in this connection appears to be to employ sufficient numbers of such men to work under the several Regional Food Commissioners who have recently entered on their duties and have now been touring in different parts of the country. In addition, a Central Research Committee or several Regional Committees of Scientists, including entomologists, chemical engineers, biochemists and others, may be set up with a view to plan and investigate urgent aspects of problems of proper storage and treatment of food grains, with the help of a body of qualified scientific workers. Food supply in India at the present juncture is second to no other problem in importance and no effort should be spared to see that the populations are well and adequately fed.