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workers should also realise their responsibility as joint investors with the agriculturists and the administrators in national progress. They should be ever mindful of the fact that the ultimate test of their labours is in the fields of the farmer; success there is their reward; failure, their incentive.

Conclusion. I shall close my paper with an appeal that this Conference now and in all its future deliberations, may discuss this subject in all its aspects and reflect the hopes and fears, the needs and necessities of the man behind the plough. It should evolve ways and means of bringing the ryot and the research worker nearer It is my hope that the College Day and Conference of the Madras Agricultural Students' Union, will form the Central Observatory, where once a year rural observations and their bearing on the trials and triumphs of Research will be recorded.

Preliminary Observations on the Insect-free Storage of Grains.

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Introduction. The successful storage of his grains free from insects is a serious problem for the ryot. The grains have to be stored for some time, longer or shorter, before a ryot can dispose them off for food or for seed and during this period they are liable to be spoiled in various ways; their suitability for food may deteriorate or they may suffer in their germinating capacity; and insects contribute largely to this damage, the loss from which may amount to several lakhs of rupees in a year. It has been calculated that *cholam* (sorghum) grains alone are liable to damage upto 25 per cent during the course of storage for a year; in very bad cases it may be more. According to the Season and Crop Report for the year 1938—39 published by the Madras Government 1,265,300 tons of cholam were produced in this Presidency in that year, valued at Rs. 94,867,500. At a low estimate of 10 per cent the loss due to insects would come to $9\frac{1}{2}$ millions of rupees. This loss has been calculated to be caused by only one species of insect – the rice weevil. If we take into consideration also other insects that take their toll, we can easily imagine, how great the loss caused to *cholam* grains in our presidency would be due to insects. Insects attacking grains are many; this paper deals with observations regarding only two of these, viz, the rice weevil on *cholam* and the paddy-borer beetle on paddy. The rice weevil, though commonly so called, is more a serious pest of *cholam* grains here than of paddy.

Methods of Storage of Grains in this Presidency. Paddy and *cholam* grains are stored in different ways in various parts of the presidency. (1) In some places they are stored openly in the pials of cattlesheds and dwelling houses rarely covered over with a loose layer of straw; in many cases they are neither cleaned well nor dried before they are stored, so that the facilities for insect infestation are plenty; such simple methods of

storage are common in parts of Trichinopoly and Pudukotah. (2) In parts of Malabar, Pudukotah and Trichinopoly, grains are stored in closed earthen masonry or wooden granaries inside houses after they are well dried in the sun. These granaries do not generally admit of the entrance of insect pests and being more or less air-tight they afford facilities for the fumigation of the grains if and when they get infested. Some of the wooden granaries in Pudukotah are ideal in this respect because they are divided into a number of independent compartments, well raised from the ground and provided with trap doors at the bottom through which the grains can be removed. (3) In the Trichinopoly District, Madura and parts of Coimbatore there is a system of storing grains in open rooms in houses after the grains are well dried in the sun; this system gives free scope for the entry of insects. In some cases the ryots put leaves of Pungam (*Pongamia glabra*) or Neem (*Azideracta indica*) over the grains in the belief that these prevent insect attack. (4) In certain parts of Coimbatore *cholam* is stored in underground pits inside houses or in the open in the yard or on the roadside. There are two kinds of underground pits. One consists of large masonry cellars 8—10 feet square at the base and 15—20 feet deep with a small rectangular opening about 2 feet square at the top covered over by wooden planks or stone slabs and plastered over flush to the ground level with clay. This type keeps the grains free from insects and grains stored in this manner for over two years have been found to be absolutely free from insects. The other type consists of round pits of uniform diameter dug in the ground: they are generally smaller than the previous type, being only 5 or 6 feet deep and 2—3 feet in diameter; these pits are lined on all the sides top and the bottom, by cholam stubble and old gunny bags, evidently to prevent the grains from coming in contact with the earth. Any space left over the level of grains is filled with earth and every time the grains are removed from these pits, more earth is put in to fill the pit completely leaving no empty space above the grains. This system of storage does not seem to have any value in preventing insect attack as grains stored like this for over 6 months were found badly infested with beetles. The grains stored in both these kinds of pits are said to lose their germinating capacity completely and therefore, they are useful only for food. Moreover, this kind of storage is said to be suitable only for *cholam*. During the storage much heat is produced inside the pit and the air trapped inside becomes suffocating so that grains from these pits could be removed only 12 hours or more after the pit is opened. (5) In the east coast districts grains are stored in round granaries known as *Kudirs* erected inside or outside houses; in the latter case they are provided with thatched roofs. The sides are made of twisted straw plastered over with clay. Some of them are made of several circular rings of straw piled one over the other and plastered together. They have an opening at the top which is closed and plastered with mud after the grains have been put in. Some of these are provided with a hole at the bottom which is kept plugged and through which the grain can be drawn out. Being practically air-tight these are expected to be insect-proof;

but they do not appear to be so in fact. Many of these were found to harbour insects which infested the grains stored in them. (6) In the Ceded Districts, South Kanara, Northern Circars and other places grains are stored in *Mooras, Mudikattus* or *Puries* which are only packages made of twisted straw and sometimes plastered over with mud. (7) Storing grains in big bamboo baskets smeared with cowdung on the outside is common in certain parts of Malabar. The prevention of insect infestation is very remote in this case. (8) Mud pots with their mouth covered and the covering plastered over with mud and tins with tight-fitting lids are commonly used for storing grains especially where the quantity is small; in these cases, of course, insect infestation is prevented to some extent. (9) A common method of storage of grains is in gunny bags in go downs and here insects usually have free access to the grain.

These are some of the common methods of storage of grains obtaining in this presidency. It will be seen that our ryots do not seem to have attempted much in the direction of prevention of insect infestation in the grains except in such cases where a few leaves of *neem* or *pungam* were scattered over the stored loose grains with the idea of keeping off insects. It is interesting to note that in certain localities the presence of the paddy moth in the grains in storage is considered to be auspicious as it is believed that such granaries would not get empty.

The Problem of Storage. The problem of storage of grains can be approached in two ways: either by preventing the entry of insects that may be in the grains before they are taken into the granary or by tackling the insects in the store; of course the former is easier and more efficient. Some of the insects that attack grains in the store start their activity when the grains are in the field and are carried into the granary along with the harvested grains. These can be prevented from entering the granary by thoroughly drying the grains in the sun and cleaning them well before storage or by fumigating the grains, i. e., subjecting the grains held in air-tight chambers to the action of certain poisonous gases. In either case the insects in the grains are killed to a great extent. Fumigation is a laborious process requiring great care and technical skill, entailing the use of extremely poisonous and often inflammable material; moreover, it requires special facilities for making the granary airtight, so that under the existing conditions in the average Indian village, it will not be possible for the ryot to undertake it. He has, therefore, only one alternative viz. to prevent insect entry and that is thorough cleaning and drying of the grains before storage. This will also be useful in keeping down the number of insects in the store as many species are unable to thrive in whole and dry grains while others require a certain amount of moisture in the grains for completing their life cycle. The weevil is indifferent to oxygen supply so that airtight storage does not prevent the insect from normal development. According to Dr. Cole " A non-ventilated atmosphere at about 80°F charged with water vapour (no matter how poor in oxygen and contaminated with carbon-di-oxide)

provides most favourable conditions for the life and reproduction of the weevil."

Insects can also be checked from multiplying in the store or even from entering the store by mixing with the grains substances distasteful to them. Some work is being done with this end in view. Experiments were conducted to test the efficacy of various substances which suggested themselves as possible protective agents against insect damage to stored grain. As far as possible only those materials that are used by the ryot or are easily available to him or have a reputation for keeping off insects were selected. Paddy and cholam grains were stored in gunny bags, as is generally done by the ryots and kept in the central farm stores allowing free access to insects. The following treatments were under trial :— (a) Leaves of *Pungam* (*Pongamia glabra*), *Tulsi* (*Ocimum sanctum*), and *Neem* (*Azidaracta indica*) dried in the shade and mixed with the grains before storage at the rate of 5 pounds per bag ; (b) Powdered Acorus (Tamil-*Vasambu*), Derris, Pyrethrum, and lime to which a small quantity of creosote has been added, mixed with the grains at the rate of 2 pounds per bag ; (c) Jeypore talc powder — a cheap substance which the manufacturers claim to be very effective in protecting grains from insects (as much as would be necessary for a thorough coating ; it took $2\frac{1}{2}$ pounds for a bag of grain) ; (d) a thorough drying of the grains in the sun for a day once a month. One bag of grain was kept as a control without any treatment. Every month one Madras measure of the grains was taken at random from each bag and counts of the population of the insects— rice weevil (*Calandra oryzoiae*) in cholam and paddy borer beetle (*Rhizopertha dominica*) in paddy were taken.

Loss of weight of grain and number of beetles collected in each lot of 200 lbs. in one year.

Treatments.	Cholam.		Paddy.	
	Loss in weight.	No. of calandra beetles.	Loss in weight.	No. of calandra beetles.
1. Control	43·2 lbs.	66135	12 lb.	10717
2. Monthly drying	23·8 ,,	11048	11·6 ,,	2400
3. *Pungam*	36·6 ,,	36580	14 ,,	7086
4. Derris	35·6 ,,	53861	11·6 ,,	2077
5. Paracide	30·4 ,,	34404	10·8 ,,	5758
6. *Tulsi*	46·8 ,,	41508	31·2 ,,	7841
7. Acorus	21·2 ,,	48792	8 ,,	2287
8. Lime and creosote	16·2 ,,	39904	8 ,,	4170
9. Talc powder	164·2 ,,	32970	13·2 ,,	13221
10. Pyrethrum	65 ,,	39901	9·2 ,,	8151
11. *Neem*	44·4 ,,	56990	34·8 ,,	7870

The above table which depicts the results of one year of experiments shows that in general *cholam* suffers more from damage by insects than paddy and that in the case of *cholam* and paddy periodical drying of the grains once a month keeps the insect population very low, that *pungam* and *neem* leaves generally used by the ryots do not give as much protection as is

claimed for them and talc powder has totally failed to give any protection at all—as a matter of fact the number of insects and the percentage of damage in this lot was the highest; the substance seems to have a further disadvantage of damaging the gunny bags in which the grains are stored; the gunny bags had to be renewed more than once during the course of the experiment. Acorus powder and lime with creosote have given very encouraging results. These and other methods of storage are being tried again for another year.

Co-operation in Agriculture with special reference to sugarcane crop in Coimbatore District.*

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That Agriculture is the mainstay of the vast majority of the population in this country and that the prosperity of the country depends on the condition of agriculture and those engaged in it, are obvious facts which do not call for elaborate arguments to convince anyone. In a world of large scale business, the agriculturists are in need of organisation, and co-operation offers the most ideal form of organisation for them. Co-peration has worked wonders for agriculturists in countries like Denmark, Ireland, Canada and the United States. In India, till recently, co-operation among agriculturists confined itself to one aspect of the problem namely credit. Such a one-sided development had consequences which made themselves felt seriously in the great Depression which set in from 1930. Now it is recognised on all hands, that the rural problem, if it is to be tackled properly, should be tackled on all its fronts. Any attempt to improve the economic condition of the agriculturists must therefore include in its scope finance for production purposes, supply of requirements and marketing of produce.

On account of the circumstances of its origin and early history, the co-operative movement is still largely a credit movement but the lesson taught by the depression referred to above has had its effect and societies other than credit are being started in large numbers. Taking the position in the districts of Coimbatore and Nilgiris, there were on 30th June 1940, 725 societies in the former and 96 in the latter. Of these 586 and 72 respectively are credit societies while the rest are for other purposes.

The following classification is intended to give an idea of the nature of work done by the different types of existing societies.

No of societies classified.	Coimbatore district.	Nilgiris district.
1. Land Mortgage Bank	11	1
2. Central Bank	1	—
3. Supervising Unions	16	2
4. Audit Union	1	—
5. Language Federation	1	—

* Paper read at the Twenty-fifth College Day and Conference of the Madras Agricultural Students' Union, July 40.