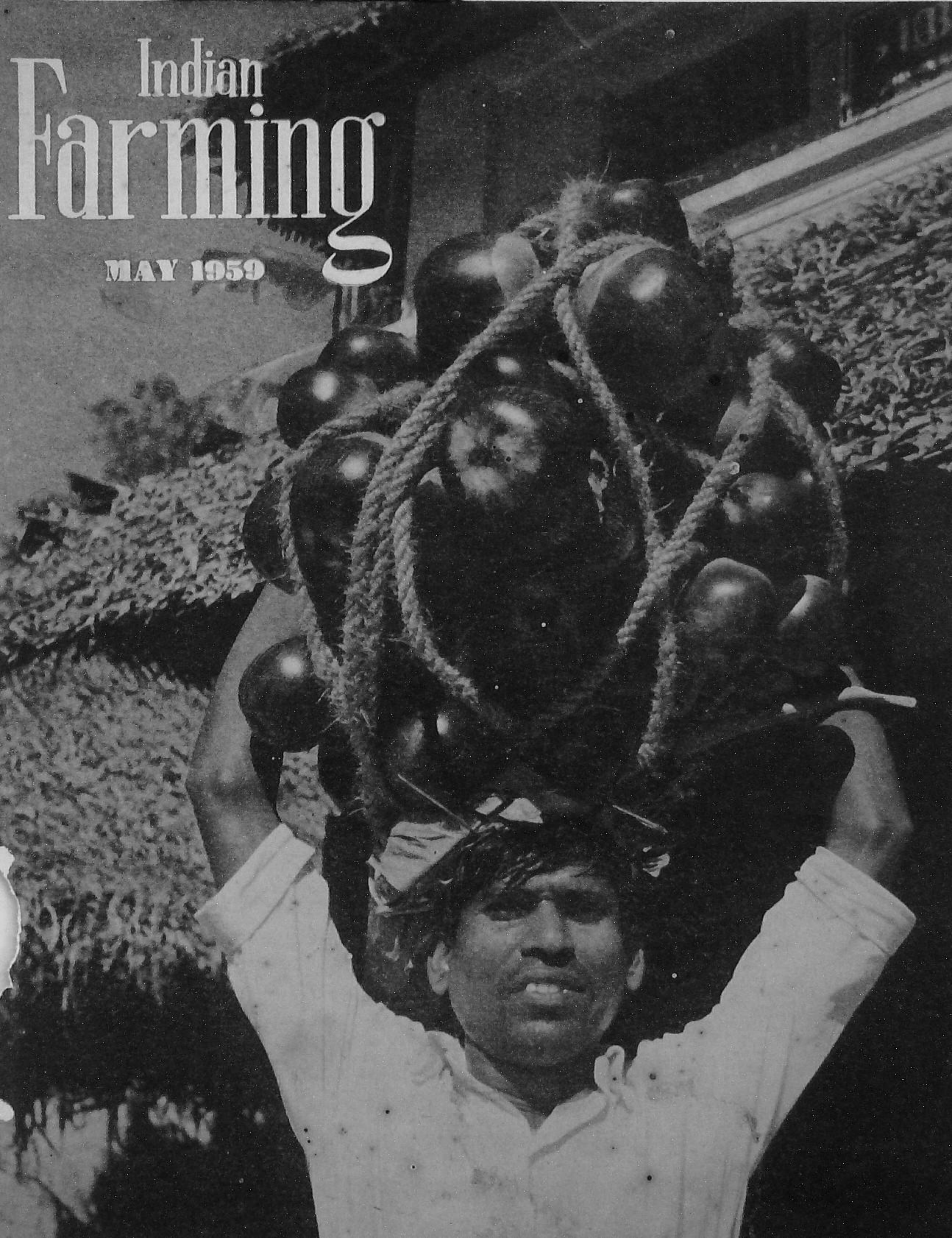
Indian Farming

MAY 1959



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ANALYSIS

7% Nitrogen 10% Phos. acid

PLUS

ESSENTIAL TRACE ELEMENTS

Calcium	8.66%	Manganese	0.0016%
Sodium	1.85%	Boron	0.0010%
Magnesium	0.003%	Iodine	0.0010%
Copper	0.005%	Cobalt	Trace

(AVAILABLE WITH ALDRIN AND 5% POTASH, IF REQUIRED)

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MAY 1959

Vol. IX No. 2

OUR COVER

A headload of ripe palmyra fruits. They yield a kernel which is sweet and delicious; it can also be canned.

Photo by H. K. Gorkha

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Indian Farming

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Editor: **Harkirat Singh**

ISSUED BY

THE INDIAN COUNCIL OF AGRICULTURAL RESEARCH

NEW DELHI

MORE SILK

SILK, the noble fibre, is an important source of strength to India's village economy. The world's fourth largest producer of raw silk, India produces not only the mulberry type but also the three non-mulberry types—tasar, Eri and Muga. The mulberry silk industry provides subsidiary occupation, directly or indirectly, to about five million rural people in Mysore, West Bengal and Jammu and Kashmir; the non-mulberry type offers employment to thousands of tribal people in Assam, Bihar, Madhya Pradesh and Orissa.

It was not until 1949, however, that the first step towards a systematic and co-ordinated development of the sericulture industry was taken by the Government, when it constituted the Central Silk Board.

Realizing that real progress of the industry would ultimately depend on intensive sericultural research, the Board is giving considerable financial assistance to the states for the establishment of research institutes and training centres. A sum of Rs. 4.48 crores has been set apart in the Second Five Year Plan for the implementation of sericultural schemes. The goal is: self-sufficiency in raw silk by the end of the Plan period.

The silkworm rearer can supplement the efforts of the Board towards achieving the goal in his own simple way: by taking such measures as will maximize production.

For example, he must use only certified, disease-free seed either from Government grainages or aided grainages maintained in the states. Also, he should secure just the quantity he can conveniently handle to avoid unnecessary wastage and losses. He must also know the details such as the race of the worms, the date of laying and the approximate date of hatching so that his operations are timely.

Feeding the worms at regular intervals is one of the most important steps in rearing silkworms. It is better to feed the worms with small quantities of leaves at frequent intervals than with large quantities in fewer feedings. Underfeeding is as bad as overfeeding. As far as possible, only fresh, or at least properly stored leaves, should be fed.

Suitable sanitation and cleanliness must be maintained in the rearing room to prevent any disease outbreak. The litter should be thrown as far away from the rearing place as possible. Congestion has to be avoided at all costs; full growth of the worms can be ensured only by spacing them properly.

Only then will worms spin better cocoons that will reel more silk.

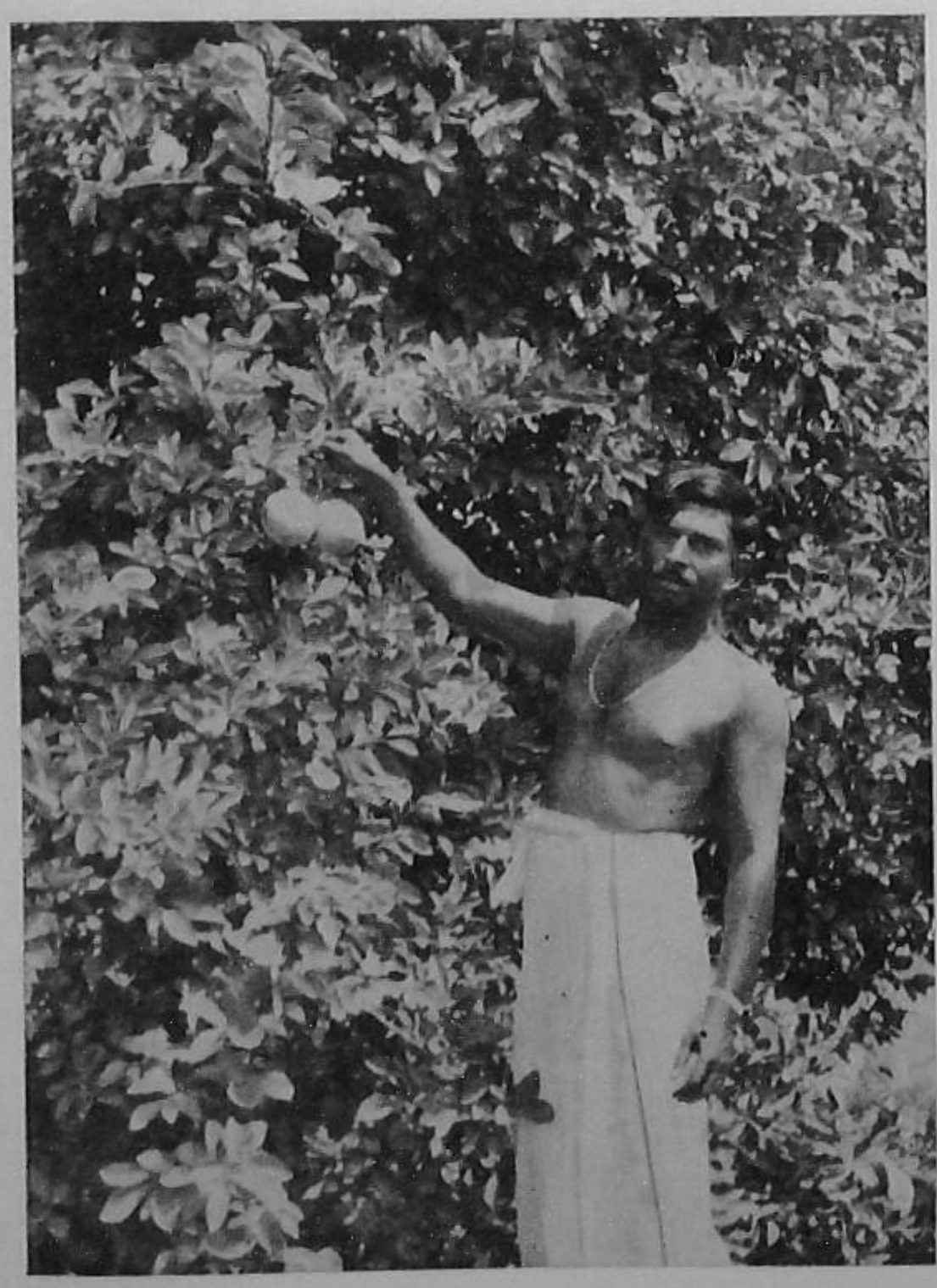
A New Idea

In Every Work

by

Harkirat Singh

"Look at the size my *Sathgudi* oranges attain," says Dhanushkodi proudly



EVER anxious to cut new ground in everything that he does—that is my impression about Shri S.A.S.M. Dhanushkodi, a young orchardist of Virudhunagar, whom I met last month. One of the four brothers of a family of traders of Virudhunagar in Ramnad district of Madras State, Dhanushkodi has been entrusted by his father with the care of the 20-acre "S.A.S.M. Marimuthu Nadar Orchard" at Pavali, about three miles from the place.

"It all started when my father planted a few trees of oranges, mangoes, limes, pomegranates and guavas on our farm just for fancy's sake, and noticed that I was taking keen interest in them," Dhanushkodi told me. "The trees came up very well, and when they started bearing, I had already drawn up a plan in my mind to embark upon fruit-growing on a commercial scale," he said. Dhanushkodi's plan did not take long to materialize, because "our usual crops—cotton, *ragi*, groundnut and *cholam* were suffering from drought each year and refusing to give good income."

In 1953, Dhanushkodi laid out the first ever commercial orchard in the area on seven acres. But as he would not tolerate any disappointment, he first made a dash to almost all the Government farms and nurseries he knew about—at Kodur, Coonoor, Kallar and Burliar—to get advice and also to purchase reliable planting material. He also visited many good private orchards that came his way during his journey.

"In fact, frequent rounds of this nature," put in the Agricultural Extension Officer Somasundaram who accompanied me, "have been the biggest factor in his success." I myself was more than convinced about this when Dhanushkodi did not rest content with showing me round his own orchard, but insisted that I also see some more round about "to compare for yourself my tree performance, fruit size and yield with theirs."

SOIL CONQUERED

The soil of the area, which is black loam, was conquered over with liberal doses of organic manures and green manuring with *dhaincha* and *Gliricidia*.

Dhanushkodi planted 125 trees of acid lime, 80 each of orange and mango, and a few each of *sapota*, breadfruit, *jaman*, *aonla*, custard-apple, grapefruit, bull's heart, citron and fig. He adopted the square system of planting.

First of all, three-foot cubes were dug three months before planting, and filled with tank-silt. Water was then applied to them till the soil settled down properly, the plants then set and basins made for irrigation.

The mangoes he pot-watered according to need for two years; the other plants he regularly irrigated by irrigation channels. Along one side of the channels he planted *Gliricidia* cuttings five feet apart. After six months, he obtained the first harvest of green leaves from them for the compost pit ; thereafter, green leaves were harvested for the pits every three months. In this way, he did not allow the green manure plants to grow more than three feet high.

Starting six months after planting, compost was applied to the trees twice a year—two baskets per plant to begin with and later increased to eight baskets. Along with the compost, one to two pounds of bonemeal per tree were also given. Weeding was done in the basins twice a year.

Dhanushkodi does not mind allowing his cattle to graze in-between the tree-rows. His explanation is that not only the weeding is automatic, but animals also get good green feed ; in addition, their dung is manure on the spot.

PROMPT SPRAYING

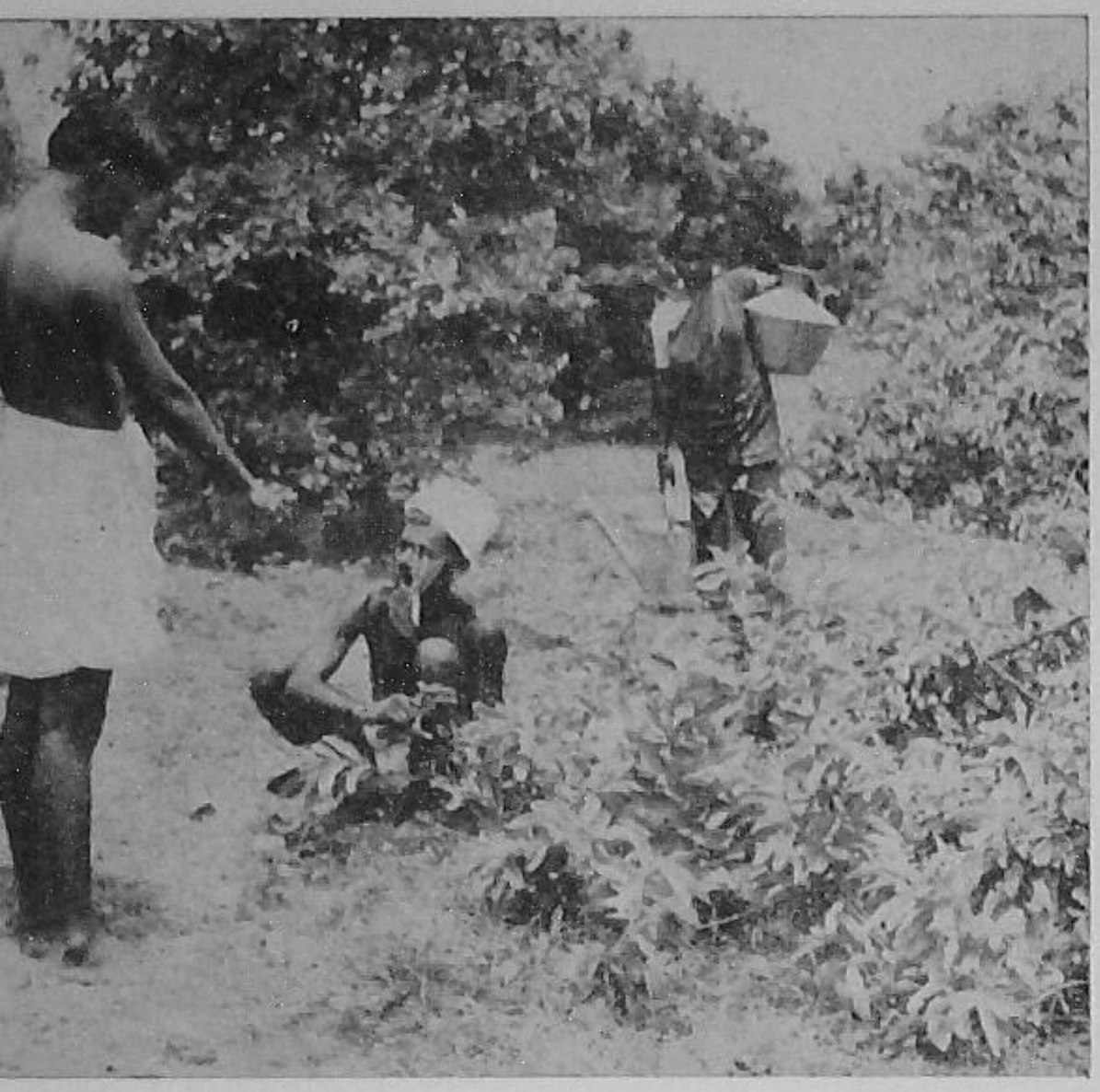
Prompt spraying of his fruit trees to keep a check on insect pests and diseases is almost a habit with Dhanushkodi. He also sprays them with trace elements if need be. The trunk base is smeared around with Bordeaux paste to prevent water stagnation. Wither tips and water suckers are regularly removed from orange trees.

Many of his friends had warned him that by A.I. he would get only bull-calves. They wondered when all the four turned out to be cow-calves

More fruit yield, honey in addition

Another thing that Dhanushkodi has tried is growing of guava layers as fillers in the centre of four trees till the main trees get established. Not only has he thus added to his income by the sale of guava fruits, of which he gets about 700 per tree, but also obtains guava layers for sale. Dhanushkodi grows 14 varieties of guavas including *Lucknow 49*, *Lucknow 46* and some completely seedless ones.

His mango grove has 47 varieties including some Kodur hybrids and choice varieties like *Jehangir*, *Himayuddin* and *Alampur Banishan*. Lemons include *Malta*,



Instructing worker watering guava layers

Nepali Round and *Oblong*, *Saville* and *Eureka*, and sweet oranges *Sathgudi* and *Blood Red*. Besides, he also has a few jackfruit trees.

DIVERSIFIED FARMING

Being a staunch believer in diversified farming, a visit to the Nadar Farm shows that there is hardly anything in which Dhanushkodi has not dabbled and not come out successful. He is maintaining four beehives because, "Books tell me that bees help in pollination and thus increase the yield by at least ten to 15 per cent." After meeting his home needs for honey, he is also able to spare some quantity for sale.

He is very keen on rearing a herd of Red Sindhi cows. Though he has not so far been able to secure Red Sindhi heifers, he is already grading up his cows through artificial insemination.

Fish rearing has not escaped his attention either. He has seeded his 40 feet × 42 feet well and one or two ponds around his farm with Gourami fish, and happily pointed out to a few well-grown specimens which came to the surface when he threw some food in the water.

He is also keeping some 20 Black Minorca poultry birds. Even though he is just making a beginning in this respect, he has tried a new idea. What he did was he put eleven eggs each under four *desi* hens for hatching, but confined all the 40 chicks obtained only with one "foster mother". "This is economical," he said, "because normally it would take six months to wean away chicks from a hen and bring it back into laying."

NEW EXTENSION

Dhanushkodi has recently added another 13 acres to his orchard. Whatever income—about 3,000 rupees a year—he gets at present by the sale of guava layers or fruits, he is investing it on his new extension.

Mesquite is popular in the area, but he must do everything in a big way; all the hedges on the Nadar farm are of Mesquite. "They serve as excellent windbreak, their prunings are good fuel and the pods a good feed for cattle," Dhanushkodi would tell you.

What impressed me most, however, was that he gives and receives new ideas equally liberally. He has a new idea to try in every work that he does, and sees to it that success is his. So far he has not seen disappointment.

NEW BOOKS RECEIVED

Co-operative Farming in Bulgaria
by Gursharan Singh
Copies available from Indian Farm Mechanization, D-46 Hauz Khas Enclave, New Delhi-16; price Rs. 6.00

An Introduction to Tropical Agriculture
by Sir Harold and D.H. Grist
Copies available from Orient Longmans Private Ltd., Calcutta, Bombay, Madras, Delhi, Hyderabad; price 40 sh. net.

An Introduction to Animal Husbandry
by K.C. Mahanta ; price Rs. 8.75

Production of Field Crops in India
by B.M. Pugh ; price Rs. 10.00
Both published by Kitabistan, Allahabad.

The Co-operative Movement in India
by E.M. Hough
Published by Oxford University Press, Oxford House, Apollo Bunder, Bombay 1 ; price Rs. 20.

Brochure on the Marketing of Lemongrass Oil in India
price Rs. 3:50 or 5 *sh.* 6*d.*

Report on the Chutney Industry in India
price Rs. 3.87 *or* 6 *sh.* 3*d.*
Both published by the Manager of Publications, Civil Lines, Delhi.

Fertilizers for More Food
by K.C. Pant
Published by the Hindustan Times Ltd., New Delhi ; price Rs. 1.00.

Breeding 10,000 Cattle
Published by the Production Division, Milk Marketing Board, Thames Ditton, Surrey, England.

Indian Sugar, Annual Number
Editor J.S. Mehta
Published by the Indian Sugar Mills Association, India Exchange, Calcutta 1 ; price Rs. 3.

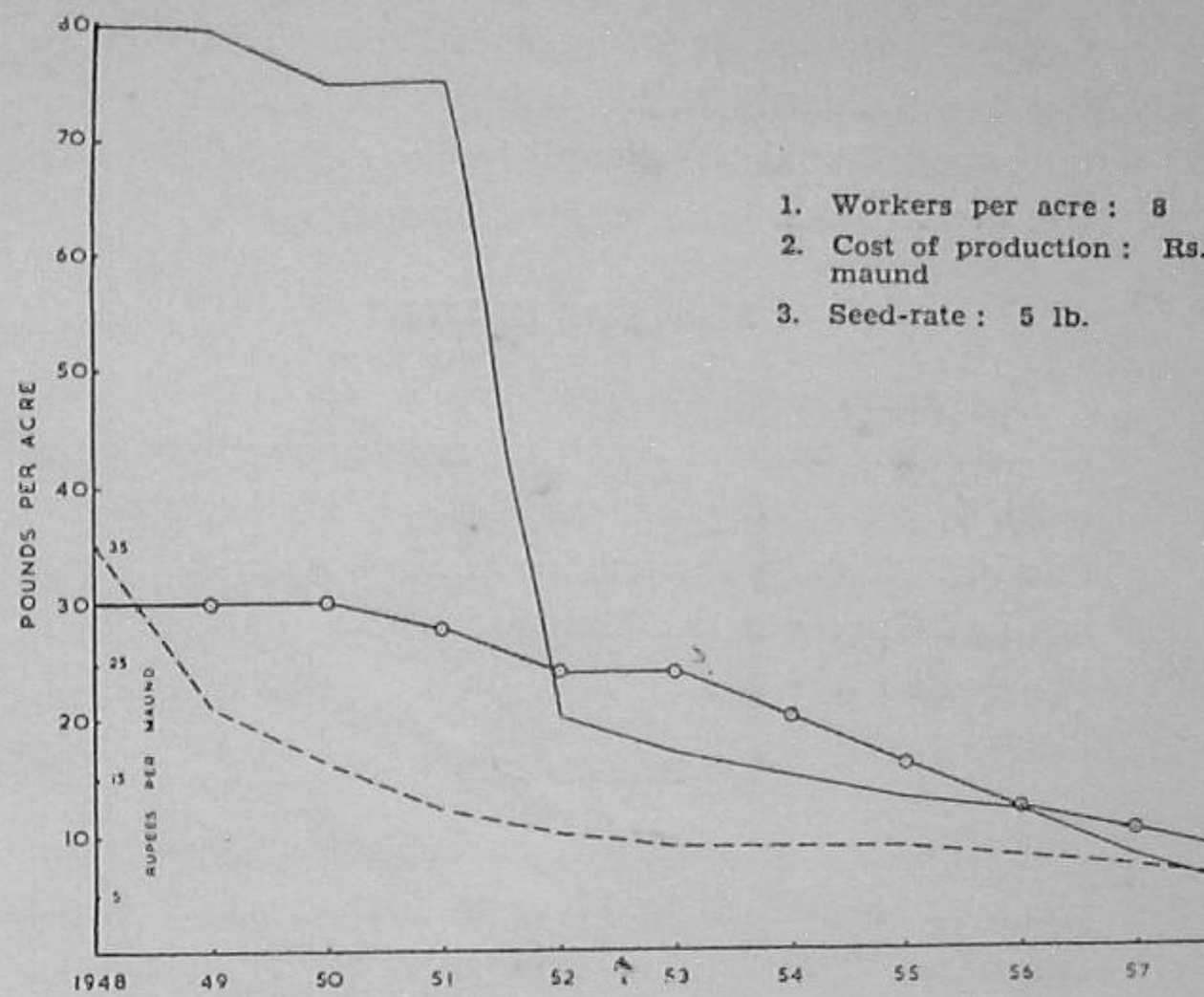
Kusum Tree, Seed and Oil
Issued by the Shellac Export Promotion Council; P 35, India Exchange Place Extension, Calcutta.

Our experience shows

It's Easy To Double Paddy Yield

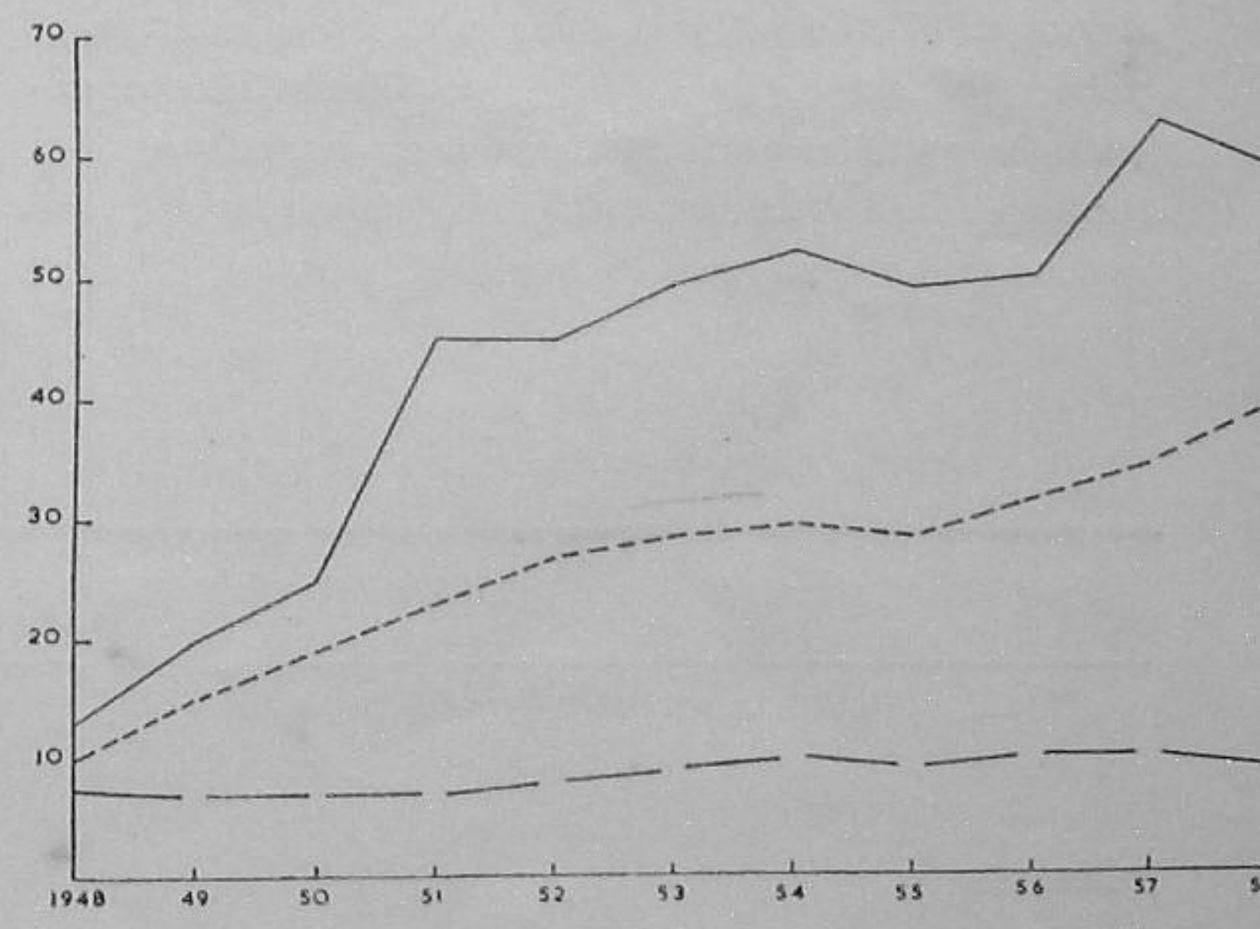
by

Pranlal S. Kapadia



The seed-rate, and so the cost of production has been cut down, and the number of workers per acre reduced . . .

. . . but the paddy yield has increased from year to year



WE, at the Kora Gramodyog Kendra at Borivili in Bombay, have been raising paddy by what has today come to be known as the Japanese method, for the last ten years or so. Our experience tells us that if we followed its simple principles on all our 7,90,00,000 paddy acres in India today, we could be sure of at least doubling our average yield of 800 pounds per acre.

The first important item is the reduction in seed-rate. At present, our farmers use about 80 pounds per acre ; the lowest is about 1½ pounds in Navagam (Ahmedabad) and the highest, 300 pounds in Chikhli (Surat). To us, five pounds seems quite sufficient. Even if we brought it down to ten pounds, it would mean a saving of 70 pounds per acre. Taking the cost of seed as ten rupees per maund (although actually it is between Rs. 15 and 17), India would be able to save not less than 20 lakh tons of seeds, or about Rs. 75 crores per year.

LOW SEED-RATE

Reduction in seed-rate helps get healthy seedlings ; production increases, as each seedling gets more manure, air and space. Fewer seedlings also permit easy weeding and interculturing, resulting in more tillers and larger yields.

If the seeds are put in a saline mixture, the solid healthy seeds will sink to the bottom and those which are not likely to germinate will float on the top. This ensures at least a 95 per cent germination. One of the reasons for our farmers using a larger quantity of seed is that the germination percentage is low.

Transplanting of a smaller number of seedlings reduces the number of workers required both for uprooting and transplanting. The Kendra used to

engage 30 workers per acre in 1948-49. This number has been reduced to eight today. The actual number of persons required should be four per acre, which will further reduce the expenditure on labour.

PLANTING IN LINES

Transplanting in straight lines makes interculturing and weeding easier. Applying manure in three doses while interculturing loosens the soil and encourages tillering. The highest number of tillers that the Kendra has had from one seedling was 235 ; the average is between 30 and 40.

RAISED BED

The raised bed method makes the seedlings transplantable within 16 to 17 days instead of 25 to 35 otherwise. The longer time thus available to the crop in the field makes for longer earheads with more grains.

ORGANIC MANURES

The Kendra was using ordinary cow-dung manure during 1948-50 and producing about ten maunds of paddy per acre. In 1950-51, fertilizers like superphosphate and manure mixtures were introduced. In 1954, use of fertilizers was completely stopped and instead organic manures such as flesh manure, digested bonemeal, gas-plant slurry, night-soil manure, green leaves, etc., produced locally utilized (See Table below). The production reached 40 maunds per acre on an average, the maximum yield being 65 maunds.

With the seed-rate reduced from 80 to five pounds and the number of workers from 30 to eight per acre, the total expenditure has been brought down from Rs. 350 to 250 per acre. Increase in paddy production from ten maunds to 40 maunds per acre has brought down the cost of production from Rs. 35 per maund in 1948 to six rupees in 1958.

ANY QUESTIONS

OR

SUGGESTIONS ?

Address these to the Editor,

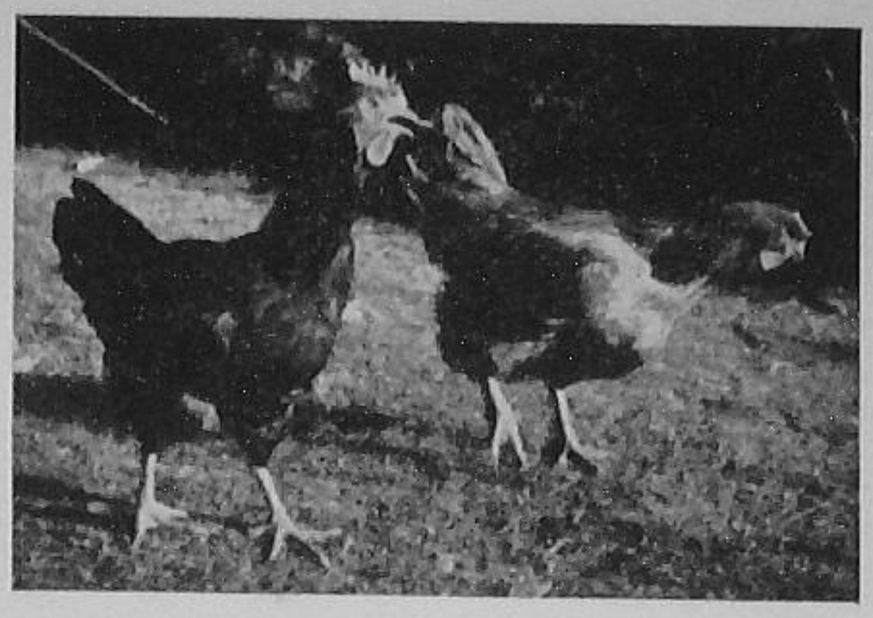
" Indian Farming ", I.C.A.R.,
Queen Victoria Road, NEW DELHI

	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957	1958
					(*in pounds*)						
Cow-dung manure (N)	100	50	50	50	50	50	—	—	—	—	—
Fertilizers											
Manure mixture (N)	—	—	—	42	42	32	—	—	—	—	—
Superphosphate (P_2O_5)	—	—	—	18	18	36	—	—	—	—	—
Potassium sulphate (K_2)	—	—	—	—	—	—	—	—	—	40	—
Organic manure											
Bone manure (P_2O_5)	—	—	—	—	—	27	54	54	54	54	40
Flesh manure (N)	—	—	—	—	—	—	24	24	24	24	24
Gas plant manure (N)											
Nightsoil (N)											
Ash (potash)	—	—	—	—	—	—	30	50	50	50	50
Compost (N)											
Green manure (N)											

No Room In A Good Flock For Poor Birds

by

J. S. Saxena *and* **M. P. Sharma**
Government Dairy Farm
Kalsi, Dehra Dun



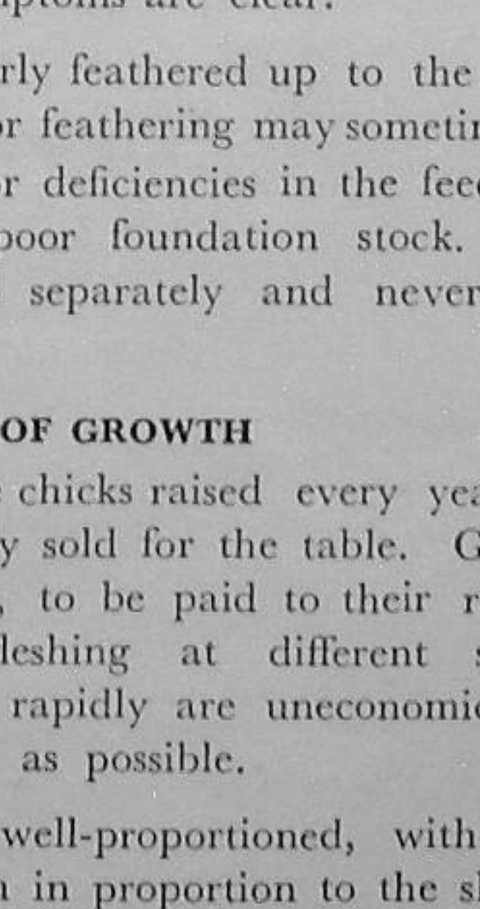
A fleshy head, small comb and an irregular body (*right*) **— signs of a poor layer. *Left* is a good layer**

MERELY starting with a good foundation stock will not ensure success in poultry-keeping ; you have also to maintain the efficiency of the flock by regular culling. There may be some chicks that do not grow well and some pullets that do not lay well. Efficient egg production can only be maintained if birds that fail to give economic returns are immediately eliminated.

Poorly developed birds in the growing stock may be the result of the poor quality of the breeding stock from which they were obtained, or faulty management. Culling of the growing stock has the advantage of saving in feed, less mortality and uniformity of the flock.

Chicks with stunted growth are unable to utilize the feed properly. They become victims of infectious diseases. The longer they are retained in the flock, the more the feed wasted; there is also the danger of the infection spreading.

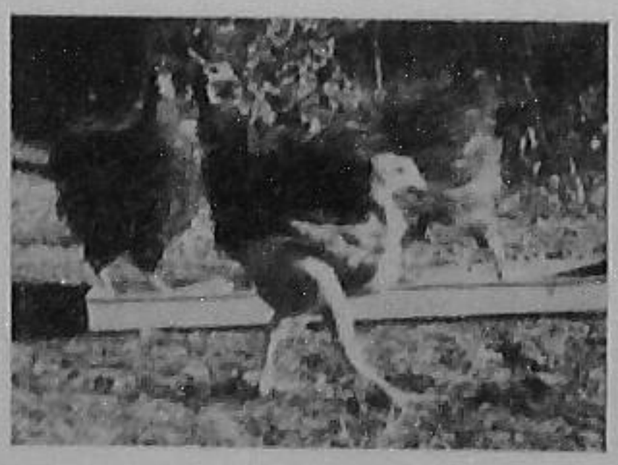
If young chicks look dumpy and huddle in a corner, it is definite that they are either chilled or sick. Droopy feathers indicate disease. Dull and sunken eyes are a



This is how you measure the laying capacity of a hen

sign of poor growth. Such chicks should be culled out as soon as these symptoms are clear.

Some chicks are poorly feathered up to the age of six or eight weeks. Poor feathering may sometimes be due to overcrowding or deficiencies in the feed, but generally it is due to poor foundation stock. Such chicks should be reared separately and never used for further breeding.



Poor feathering, poor growth

RATE OF GROWTH

About one-half of the chicks raised every year are cockerels and are mostly sold for the table. Greater attention has, therefore, to be paid to their rate of growth, shape and fleshing at different stages. Cockerels not growing rapidly are uneconomic and should be sold as soon as possible.

Healthy chicks are well-proportioned, with good length, width and depth in proportion to the shanks. The keel is parallel to the back, so that body-depth is uniform from front to rear. Fleshing is influenced by the feed, the grain consumed and management. Overcrowding and internal parasites also retard

growth and fleshing. Culling of extremely long-legged and narrow-bodied birds is important. Birds that are culled should be reared separately till they are fit for the market.

Cockerels and pullets should be separated at the age of 12 weeks and kept in separate houses. If reared together, growth may be poor. Cockerels to be kept for breeding may be selected on the basis of the standard requirements of the breed as regards body-length, eyes, head and flesh. The pullets must possess vigour as indicated by a bright, prominent eye, a stout beak, a broad head, bright yellow shanks, lustrous plumage and good fleshing. Leghorn pullets should start laying at the age of about 150 days and general-purpose pullets, at the age of about 170 to 180. At laying, they should weigh about three pounds and 4½ pounds, respectively. Plenty of body-capacity is essential for heavy egg production. Defective pullets should not be allowed in the breeding pen.

MOULTING

The time and duration of moulting are the primary factors in selecting a uniform stock for efficient production. Under Indian conditions, the ideal period for artificial hatching is mid-September to the end of March. Birds that lay during this period fit into the economy of the poultry breeder. Those which moult during this season are not economical as their performance would be minimum during the winter and optimum during the summer when the returns from eggs are lower and artificial hatching not possible. Birds that lay till May and moult thereafter suit the hatching programme.

Early moulters are generally poor layers and also take longer for moulting. Such birds remain unproductive from four to five months at times, or lay very few eggs. Late moulters take only two to three months; some high producers may take four to five weeks only and resume production before the new plumage is fully grown.

POOR LAYERS

Poor layers consume practically the same amount of feed as good layers. Hence, cull them out early in the laying season to eliminate the chances of their eggs hatching. Birds that have laid well for a short period but have stopped laying for some reason or other should also be culled.

Culling should be done in the afternoon, 3 P.M. onwards, by which time most of the eggs for the day would have been laid.

To ascertain whether a pullet is laying or not, examine the comb, the wattles, the pubic bones, the vent and the abdomen.

When a bird is laying, the comb and the wattles are warm, fully developed, bright red and waxy in appearance. In a non-layer, they are cold, dull in colour and shrunken.

The pubic bones of a laying bird are spread apart, usually from two to three fingers wide. After a bird has been laying for some time, the pubic bones become thin and pliable. In a non-layer, the pubic bones are so close that only one finger can be placed between them.

The vent of a laying bird is oval in shape and moist, while that of a non-layer is small, round and dry.

The abdomen of a laying bird is soft and expanded, the skin soft and pliable. Usually, three or four fingers can be placed between the end of the keel and the ends of the pubic bones; in a non-layer, the abdomen is usually contracted, with the skin relatively thick and coarse, and only one or two fingers across.

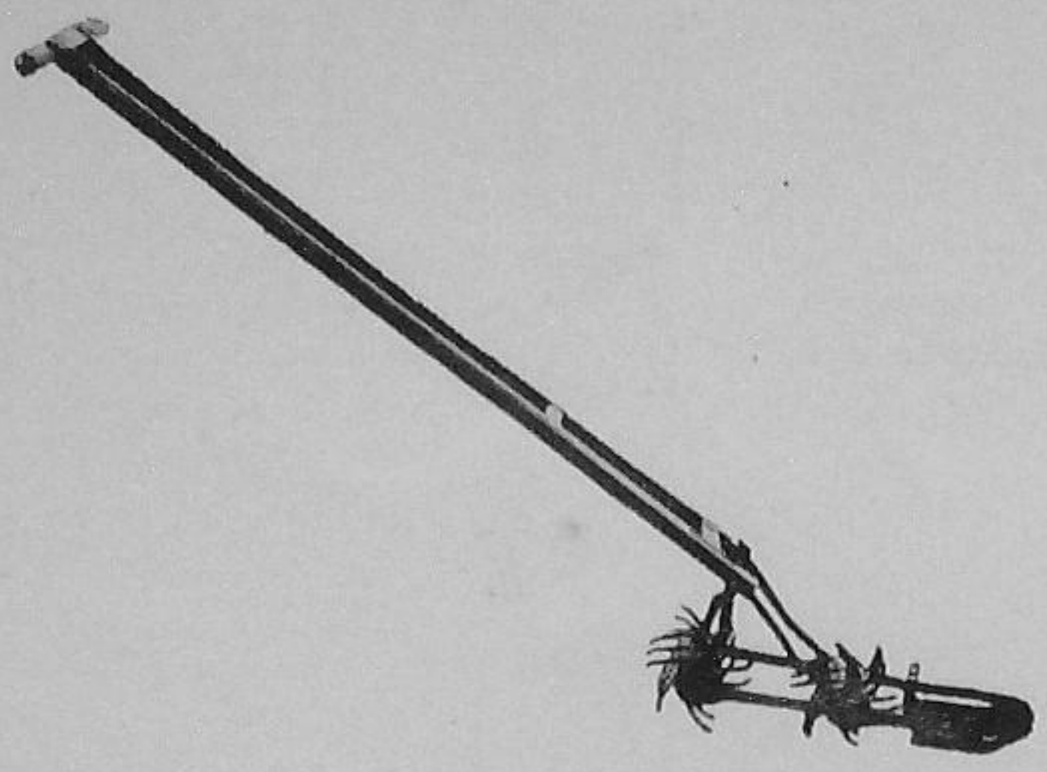
BLEACHING

Birds with narrow beaks and heads and with extremely coarse, fleshy type of heads are usually poor layers. In all yellow-skinned breeds, there is an abundance of yellow pigment in the beak, shanks, toes, the vent and the eye, rings, and in the white of the earlobes in breeds having white earlobes. When a pullet starts laying, the yellow pigment is diverted to the yolk of the egg instead of to the beak, shanks and other parts of the body. As long as the egg production goes on, these parts appear bleached; the yellow pigment is restored when the birds stop laying.

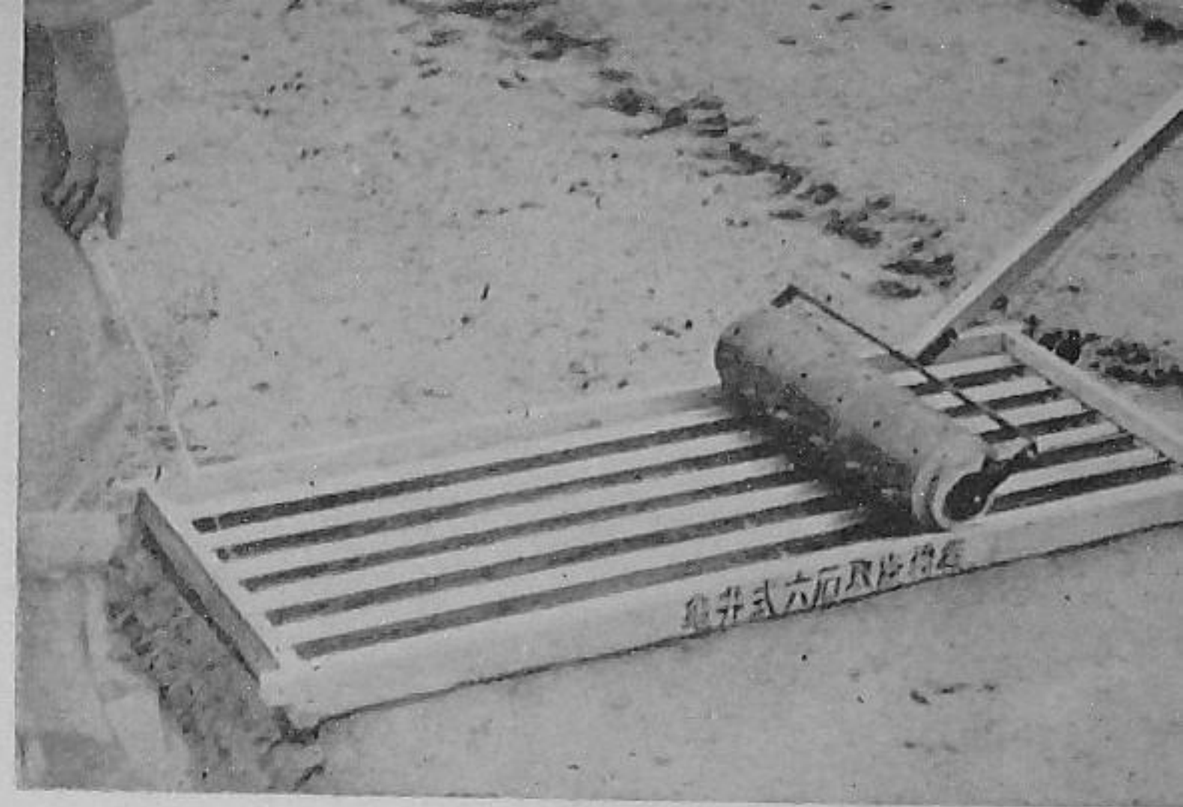
The yellow pigment is derived from the carotene in the feed. Yellow corn and green vegetables like berseem, alfalfa leaves, cabbage, cauliflower, green *doob*, etc., are rich in carotene. If white corn and other feeds which lack the yellow pigment are fed, the pigment of the beak and the shanks may fade even when the bird has laid only a few eggs. Therefore, in taking the yellow pigment as a pointer, the kind of feed should also be taken into account. When birds with yellow skin are fed a diet rich in carotene, the extent of bleaching is a good indication of the previous egg production.

After considerable egg-laying, the pigment disappears from the different parts of the body in the following sequence: (*i*) the beak, (*ii*) the eye-ring, which is formed from the inner edges of the eyelids, (*iii*) the earlobes in breeds having white earlobes, (*iv*) the beak, beginning at the base and then to the tip and (*v*) the shanks, disappearing first from the front and later from the rear. Under average conditions, a completely bleached beak indicates that the hen has been laying for four to six weeks. When the bird stops laying, the pigment is restored in the different parts of the body in the same order in which it had disappeared.

Also keep in mind that only such breeding fowls should be retained on the farm as lay enough eggs per year to earn their keep. Hens that lay less than 150 eggs per year are not economical.



A single-row weeder



The paddy seeder is simple in construction, but useful

Why Not Try These Japanese Aids?

by

J.S. Manku *and* **R.P. Singh**
Indian Agricultural Research Institute,
New Delhi

ALONG with the Japanese method of paddy cultivation, a number of Japanese machines and implements have also been gaining popularity in India. Some of these machines have been tried at the Indian Agricultural Research Institute, New Delhi, and found useful. Here are they briefly described.

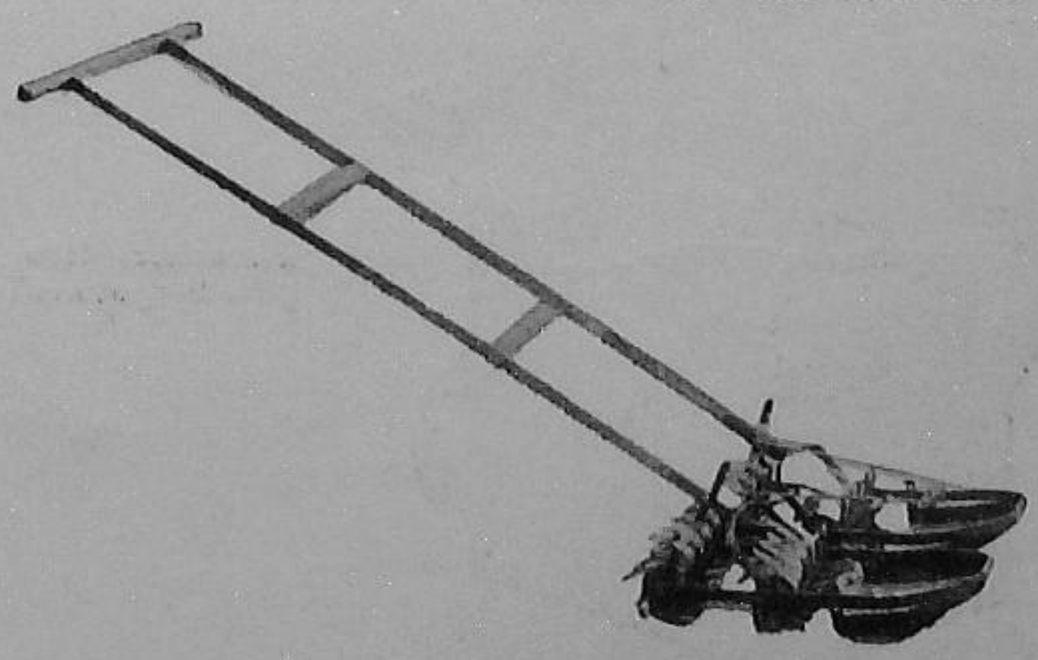
PADDY SEEDER

This is used for sowing seeds in the nursery. It is a hand-operated implement and consists of a wooden frame with equidistant rows cut into it, and a drum. The drum has a number of holes in rows spaced four inches apart and is provided with a handle.

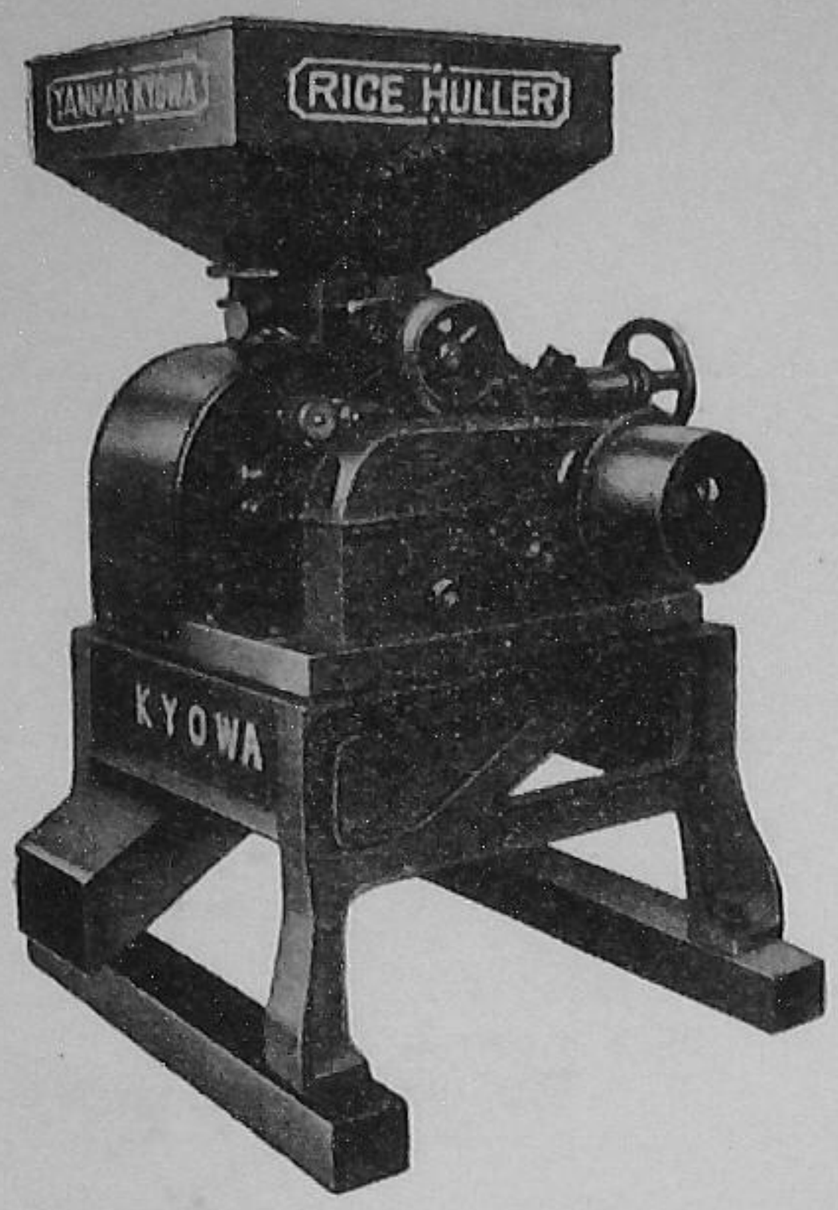
The drum is filled with seeds and rolled over the frame which is kept over the seed-bed. The seeds drop in the required quantity at equal distances in rows. The seeds are then covered with a layer of charcoal or husk-dust or sawdust and pressed with a roller or a straight board.

WEEDER

There are two types of weeders—single-row and double-row. They are used in the field with one to two inches of standing water. The single-row weeder is operated by one man, but the double-row one requires two men—one to push it and the other to



Weeds two rows at a time



Rice huller operated by power

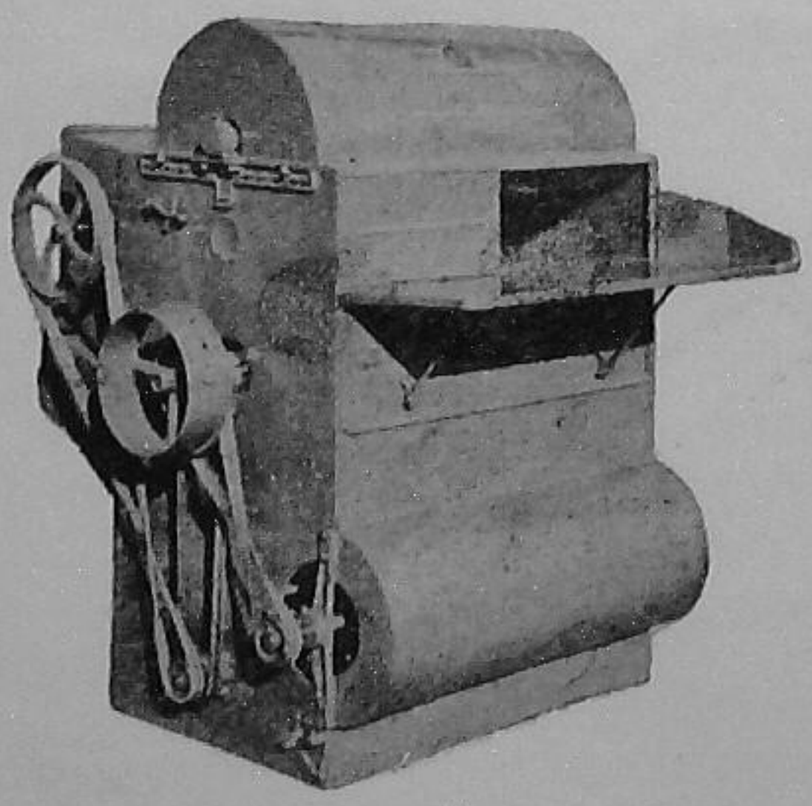
pull it with a rope tied at its centre. The handle is adjustable to suit the height of the operator.

The output of the single-row weeder is about 0.3 acres per day of eight hours, and its price Rs. 20 to 35.

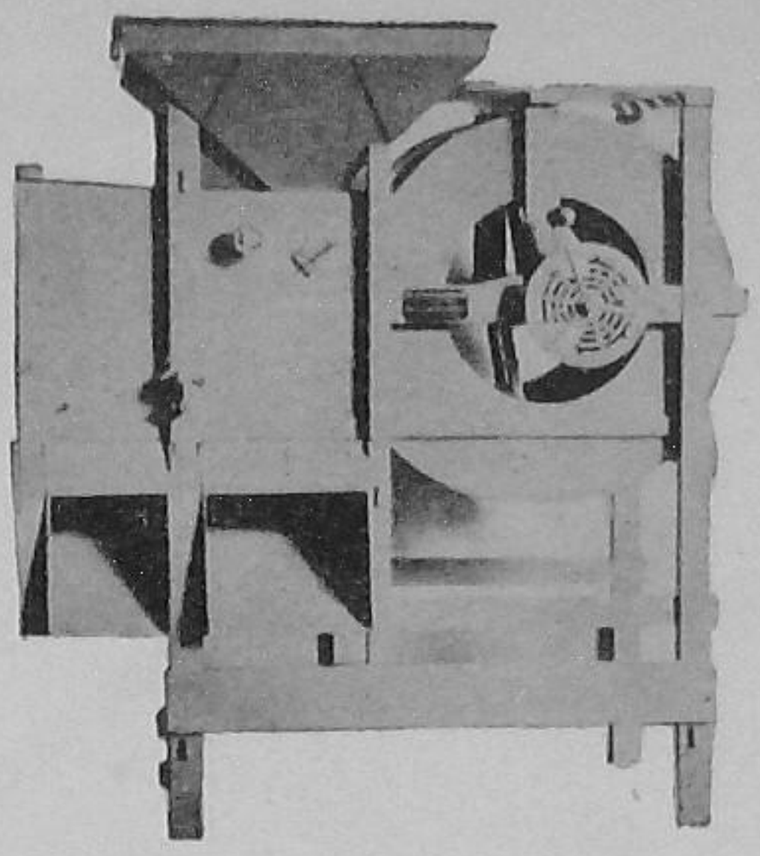
THRESHERS

The Japanese paddy threshers are pedal-operated as well as power-operated. The pedal-operated threshers are available in two sizes—the one-man type and the two-man type. The operator stands behind them and works the pedals with his feet. Paddy stalks tied in convenient bundles are held over the rotating drum for threshing.

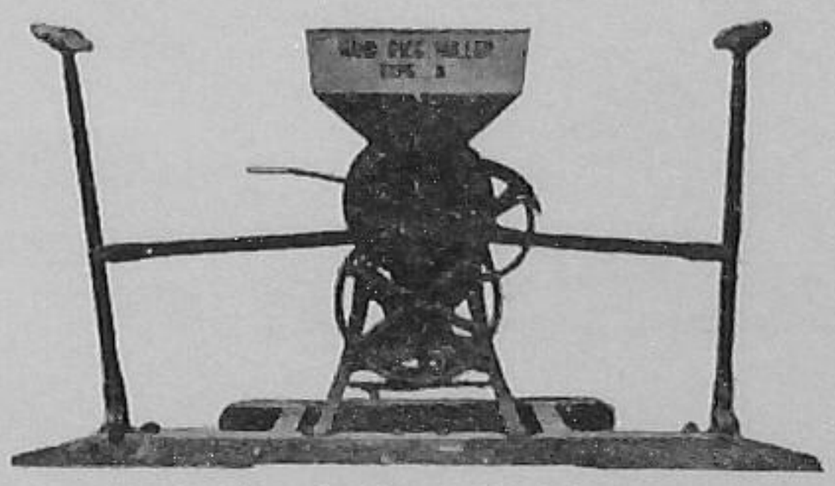
The output of a single-man thresher is about 688 pounds per day of eight hours, while that of a two-man type is nearly double that. A single-man thresher is available for about Rs. 150.



Thresher, also power-operated



Winnower and...



...huller, both worked by hand

The power threshers are similar to the pedal-operated threshers and have provision for running with a belt from an electric motor or engine. These threshers require about 5 H.P. and have an output of about 200 pounds per hour.

HULLERS OR SHELLERS

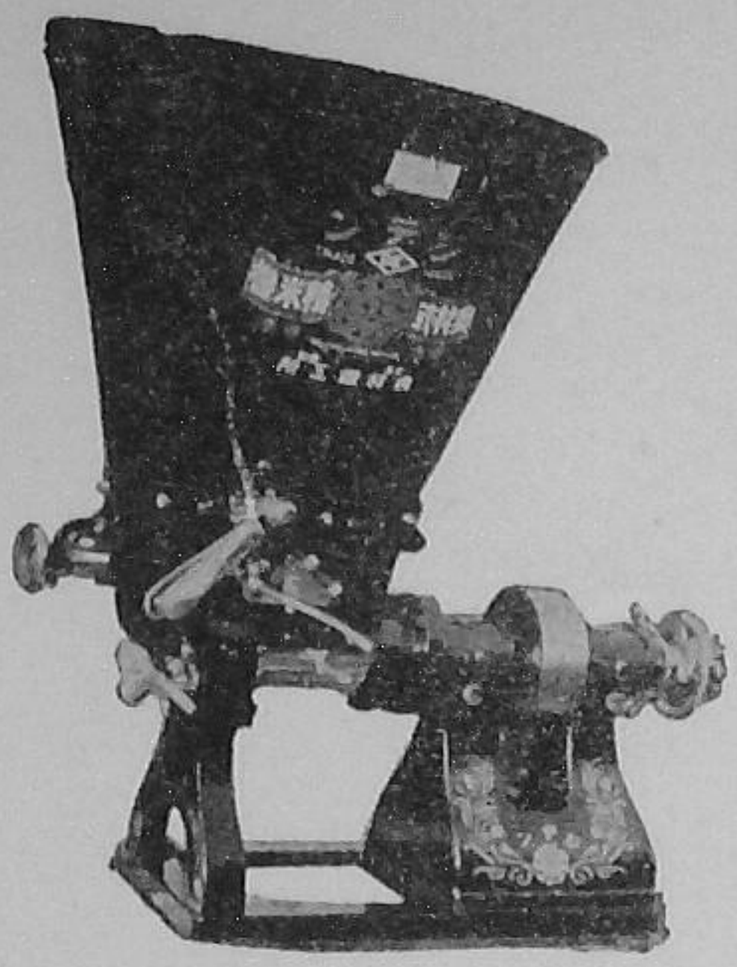
Hullers or shellers too are either manually-operated or power-operated. The manually-operated hullers are worked by two men and have an output of about 246 pounds per day of eight hours. The power-operated hullers require 2 H.P. and give an output of about 220 pounds of paddy per hour. The amount of breakage in both the cases is very small.

GRAIN WINNOWER

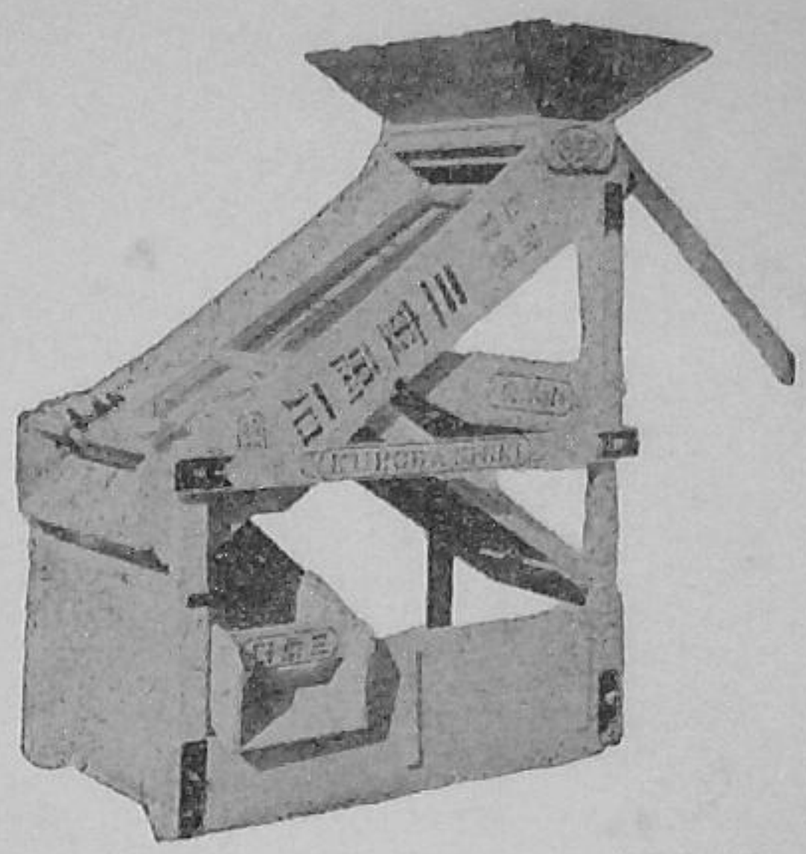
This separates rice grains from husk, and is manually-operated.

GRAIN SCREEN

This sorts out different sizes of rice grains. The grains are fed to a hopper at the top, from where they roll down on to a set of wire screens. This machine has also been tried with success on wheat, oats, etc.



Polishes rice



Screens grains

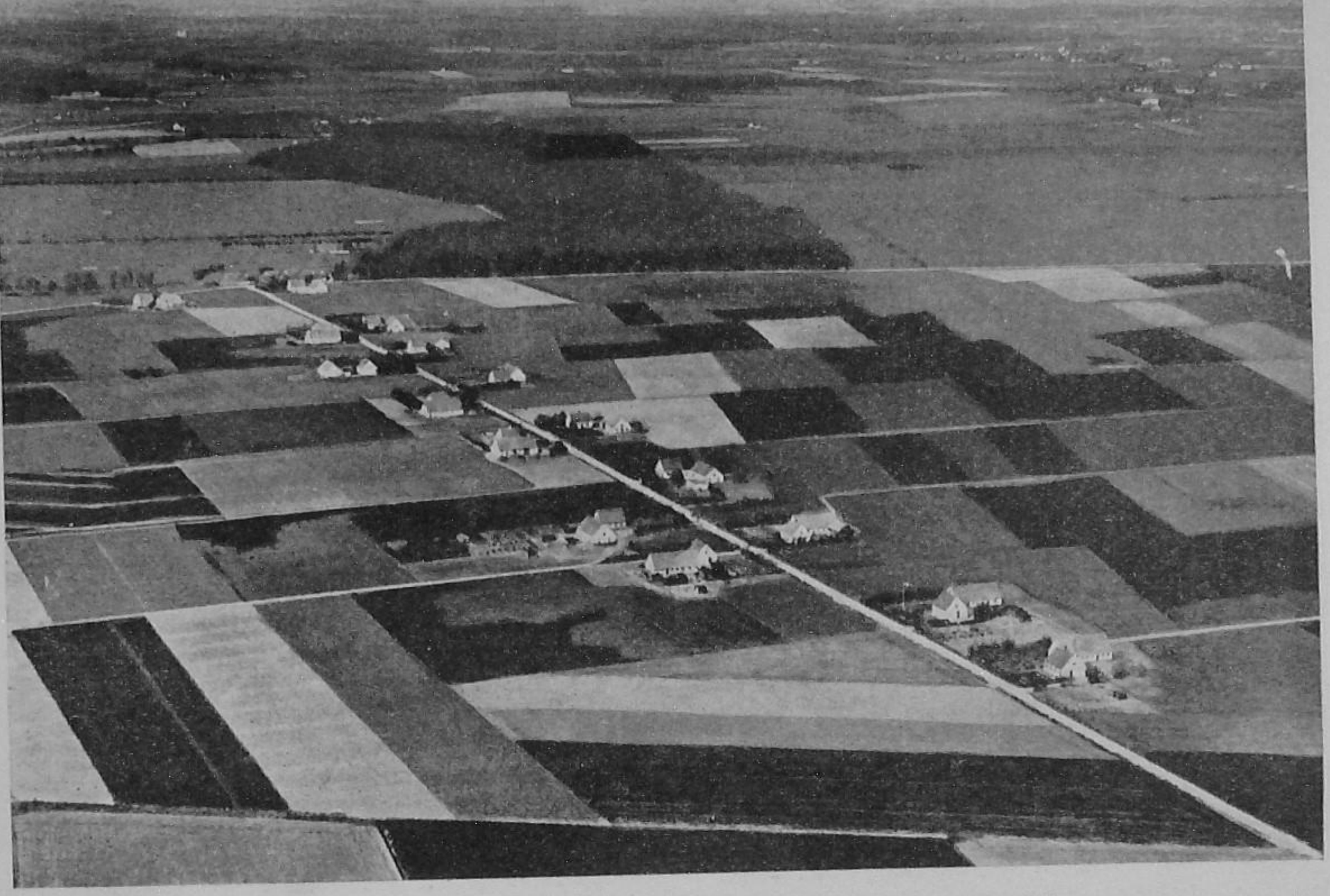
The output of this screen is about 400 pounds of separated grains per hour. It can be prepared by an average carpenter-*cum*-fitter at a cost of Rs. 80 to 100.

RICE POLISHER

This is a power-operated machine, requiring about one H.P. It gives about 136 pounds of polished rice per hour.

In addition to the above machines, an automatic rice hulling machine is also available, which is a combination of the power-operated huller, the winnower and the grain screen. It also has an elevator. It hulls the paddy, winnows the husk, and then carries the rice to the grain screen at the top.

It requires about 5 H.P. and gives an output of about 850 pounds per hour. The price of such a machine in India is about Rs. 3,000.



Danish farms as seen from air; at least half of them are small holdings

The structure of Danish agriculture has undergone considerable changes in recent years owing to mechanization. It is only by competitive production that the industry can maintain its exports. This is the key to the persistent efforts to increase production and efficiency, cut production costs and improve quality.

by
Clemens Pedersen

DANISH FARMERS AIM AT INCREASED PRODUCTION, BETTER QUALITY

DANISH agriculture has long been predominantly an export industry. Roughly 60 per cent of the gross returns come from exports. It follows that the industry's earnings are largely dependent on opportunities in foreign markets. Its chief efforts are aimed at organizing and adapting production to these markets and at making full use of the various opportunities presented. This traditional policy was resumed as soon as the abnormal post-war conditions permitted, and has been purposefully pursued since. The establishment of the Danish Agricultural Producers Information Service in London in 1947 was an important part of the policy.

But marketing opportunities are restricted by the fact that nearly every other country, and at any rate every important food-importing country, pursues an agricultural protectionist policy by means of tariffs, embargoes, quotas, guaranteed prices and markets, subsidies, and other measures. Although Danish farmers always hope for and advocate the abolition of such discriminations, these have remained a prominent feature of agricultural policy and have on the whole to be taken as they are.

Danish agriculture, therefore, can only maintain its exports by virtue of competitive production. This is the key to the persistent efforts of Danish farmers to increase productivity, cut production costs, and improve quality—efforts which have extended over generations but which, owing to force of circumstances, have been of unprecedented intensity during the period since the war.

Some of the more noteworthy developments in recent years are outlined below.

EXPANSION OF PRODUCTION

The volume of agricultural production has risen considerably. An increase was to be expected after the wartime shortages of raw materials, but figures from the fifties clearly demonstrate that the output is substantially higher than in the late thirties. The aggregate yield of crops is 15 to 20 per cent up and the production of meat, bacon, eggs and poultry shows a similar or bigger increase, while milk production is at approximately the same level as before the war. The index of all agricultural production reached the pre-war figures in 1949-50 and has since risen by 35 to 40 per cent.

Older type, straw-thatched outbuildings exist side by side with modern stables *(background)*. **The cattle seen are heifers of the red Danish breed**

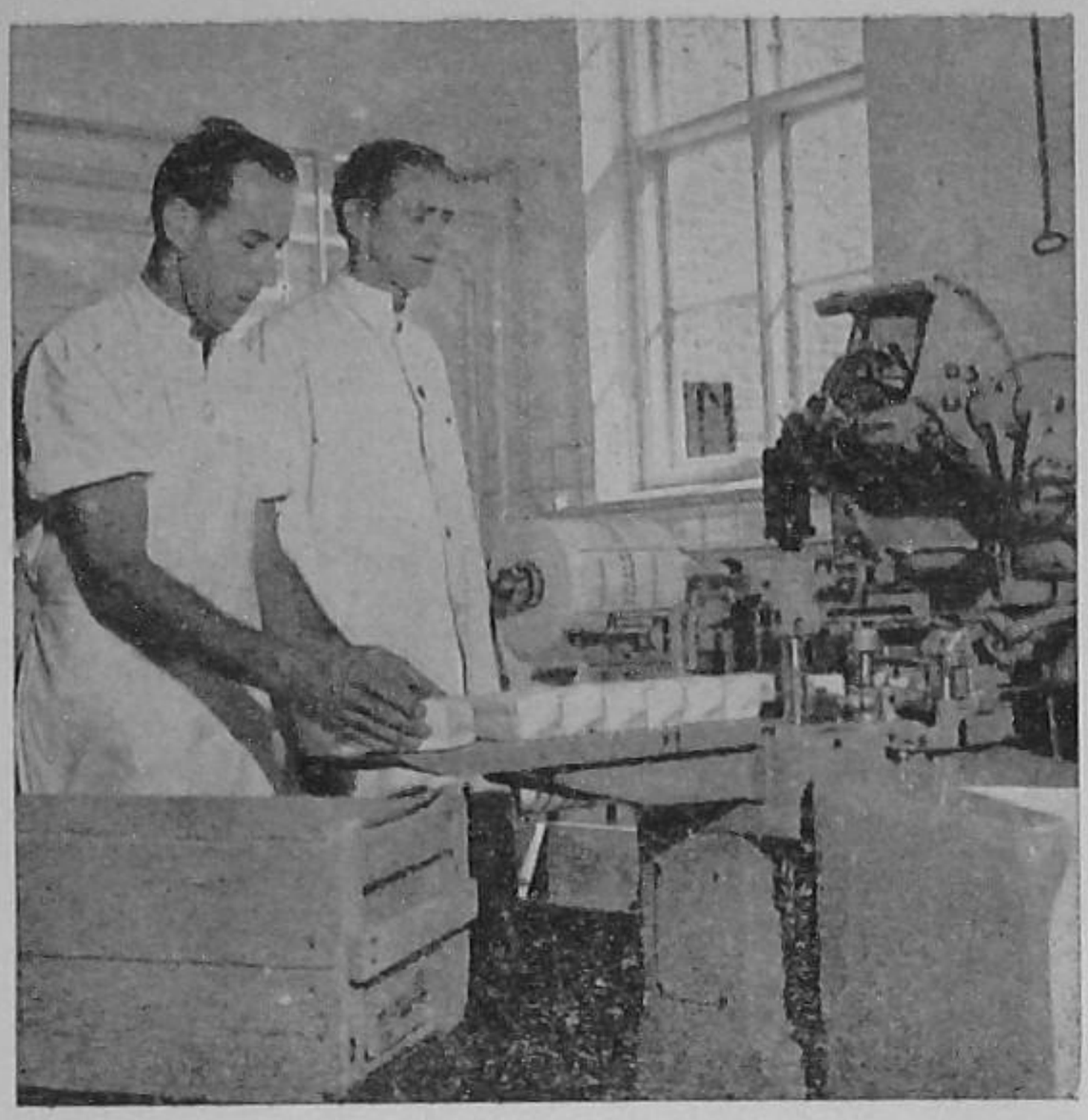
The expansion in production has taken place in spite of a small reduction in the agricultural area (totalling 3,100,000 hectares, or roughly 7,500,000 acres), owing to the growth of towns and new road construction, a decline in agricultural manpower by one-third, a reduction in the number of horses by two-thirds, and reduced imports of grain and other feeding-stuffs. It has taken place because of intensive mechanization (86,000 tractors and 134,000 milking-machines in 1958 compared with about 4,000 and 30,000, respectively at the end of the war) and the employment of intensified research, breeding and information services which in recent years have resulted in rationalized campaigns against weeds, pests, and diseases, more rational breeding and feeding of dairy cattle, pigs and poultry, more practical building arrangements, and other improvements.

It is no exaggeration to say that all the country's 200,000 farmers—virtually every one of whom is freehold and independent—have kept abreast of this technical advance. They have done so voluntarily, guided only by the advisory officers of their own organizations, their agricultural press, meetings, and by similar means, and by the need to raise earnings and cut costs.

MODERN AIDS

The changes which have been mentioned imply essential changes in the whole structure of Danish farming. The manpower decline has been so great that the agricultural population is now no more than 17

Maturing of cheese at the Danish Government Research Institute on Dairy Industry



Before it leaves the Dairy Industry Institute, butter is packed in aluminium foil

A binder in use at the Danish Government Experimental Farm at Favrholm

to 18 per cent of the total population. As it is the hired labour which has been lost, more and more farms have actually become family holdings which are worked by the farmer and his wife and children only. With the help of a tractor (their own or a hired one), a milking-machine and other electrical aids, a family can cope with a larger holding than formerly and there is a considerably reduced need for hired men and boys.

The year 1953-54 marks a turning-point. Up to then, hired farm workers did more than half the work, but since then the farmers and their wives have done most of it and their share is increasing year by year. The family holding still benefits from Government interest expressed in legislation which provides for partition and prohibits amalgamation of agricultural properties. The number of holdings has nevertheless declined from about 210,000 at the beginning of the forties to just under 200,000 today, though the reduction is chiefly in holdings too small to provide a family with a living and employment.

Though agriculture thus comprises a smaller proportion of the population and an even smaller proportion of the employment market, and though agricultural products no longer occupy the all-dominant position in Danish export figures they used to, because manufactures fortunately now find greater scope than before—it would be a mistake to interpret these facts as an extensivization of agriculture or a decline in any other respect than these. As already mentioned, production is steadily increasing and the transfer of manpower from agriculture to industry is merely a reflection of the relentless regard for productivity and efficiency which is forced upon Danish farmers.

TUBERCULOSIS EXTERMINATED

The technical and economic organizations of Danish farmers, which have been the industry's strongest support for more than a century, could point to numerous recent examples to show how the deliberate policy of raising production and quality is being pursued and adapted to market demands.

One such example is that proud day in 1952 when it was announced that tuberculosis had been eradicated from Danish cattle herds after two generations of intensively organized campaigns. From that date the "Lur" quality trade mark on exports of Danish dairy products has also been a guarantee that they are made from the milk of attested tuberculin-free herds.

Another example was the establishment in 1954 of the Bacon Factories Research Institute at Roskilde, whose research work has already provided both bacon factories and pig breeders with much valuable guidance in the improvement of their products and the reduction of the costs of production.

CONTINUED ON PAGE 25

WHAT'S NEW IN FARMING

RAISING ONION SEEDLINGS

BETTER raise onion seedlings on raised beds in the *kharif* season and on flat beds in the *rabi*, say experiments at the Niphad Agricultural Research Station in Bombay State.

Also, for better yields use seven to eight-week old seedlings for transplanting for the *kharif* and eight to nine-week olds for the *rabi* crop. In both the cases, avoid crowding in of seedlings.

The best spacing for onions: five to six inches between rows and three inches in the row.

A better seed crop is obtained by planting large-sized bulbs, and in the fourth week of October. For such a crop, a spacing of two feet between rows and a foot between bulbs is beneficial.

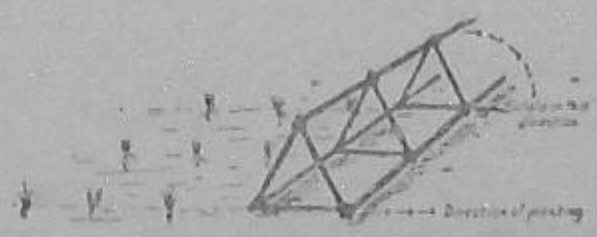
PLANTING-FRAME FOR PADDY

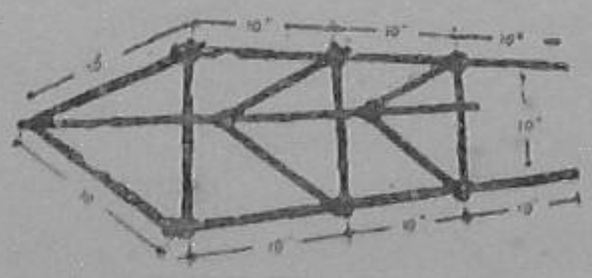
AN easier way of planting paddy seedlings with an even spacing is to use a bamboo planting-frame. The frame is commonly used in the Philippines.

The frame consists of three bamboo triangles. The length of each side is kept according to the appropriate spacing between rows advocated in the locality, say, ten inches. The bamboo triangles are fastened together at the corners to three horizontal bamboo sticks so that the space between two triangles is equal to that recommended for adoption between plants.

When planting, the frame is placed at the edge of the puddled field. The planter reaches over and plants seedlings at the base of each triangle. He then steps back and rolls the frame by one turn towards himself. This brings the frame ten inches back, ready for planting a second row of seedlings at the base of the three triangles. This is repeated till the planter reaches the end of the field.

The planter can then turn round and plant another series of rows of





seedlings on his way back.

With this simple frame, a single person can plant a field all by himself.

In case several planters have to work together, the frame should have a ten-inch extension on the horizontal bamboos. This will enable the planters to keep their planting-frames ten inches apart.

One advantage of the system is that two extra persons to hold and move the string normally used are not required.

* * *

MORE FISH WITH UNDERWATER LIGHTS

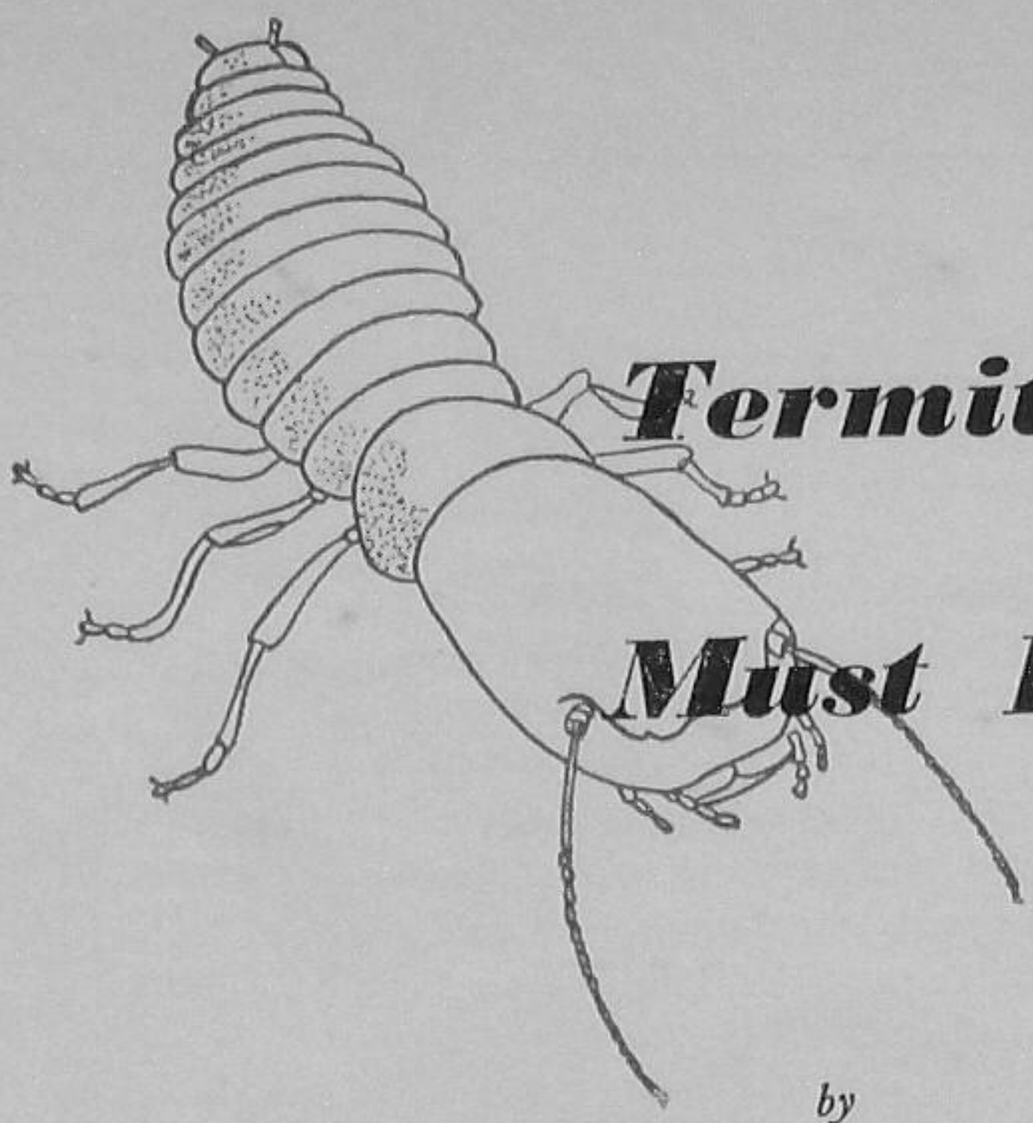
Asian fishermen are expecting to greatly increase their catches by turning on some underwater lights. A new underwater electric lamp, already used with good effect by Italian and other Mediterranean fishermen, is being introduced into the Indo-Pacific region.

The lamp is much more efficient than the traditional above-the-surface kerosene or gas lamp used to lure fish at night. The method of using the new lamp is as follows.

Before sunset, a large boat tows two small boats each fitted with the lamps, to the fishing ground. The small boats are anchored at a considerable distance from each other. When fish appear, the large boat "shoots" its net around the lighted area where the fish have gathered.

The advantage of the new lamp is that it can be made easily by fishermen. Since it is used under water, no light is reflected from the sea's surface and it is cheaper to run than the old type of lamp because less power is necessary. Its light also is steadier than an above-the-surface lamp which shines unevenly, especially when the sea is choppy.

—World Farm News



Termites Must Be Tackled

by

D.K. Sharma

HOW serious a pest these termites are would be clear from just one example: they knock off 33 per cent of the cane-weight and one to four units of the sugar content in our sugarcane belts where their infestation is 15 to 30 per cent.

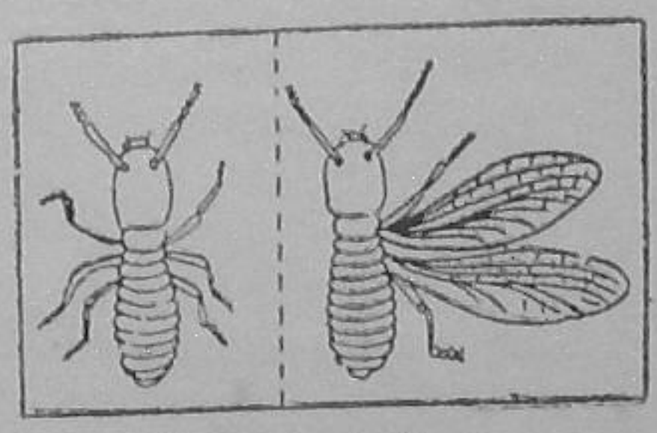
Termites are small, soft-bodied insects living always in darkness, either in the soil or dying timber or other vegetable matter. There are different species of termites in our country, some building huge earthen mounds on the ground, others nesting in dry timber and still others living completely inside the soil. When they have to come out for feeding, they build earthen galleries to protect themselves from the outside light and heat.

Termites have existed for millions of years. Originally, they were scavengers of dead wood in forest areas, but as woodlands were cleared, their natural habitat was reduced. Today they are forced to seek their food in wooden buildings and standing crops like cotton, chillies, groundnut, coconut, wheat, *jowar*, *bajri*, maize, *ragi* and other millets.

Amongst the fruit trees, mango and citrus plants like lime, grapefruit, orange, *mosambi* and *sathgudi* are their common targets. Attacking mainly the roots, they also damage plants by hollowing out their stems. Cuttings used for vegetative propagation of crops, like sugarcane, fall an easy prey to them. Termites also attack trees, shrubs, ornamentals and lawns. They are also a serious pest of stored grains.

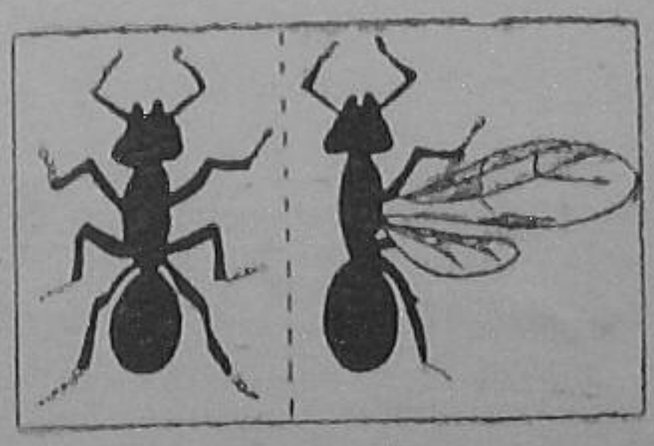
TERMITES AND ANTS

Termites resemble ants, and are often mistakenly called white ants. However, the termite has a broad waist, unlike the narrow and wasp-like one of the ant. It is often hard to distinguish winged termites from winged ants, because they are seen swarming and in flight about the same time each year—spring or fall. They, however, differ in their wing-size: while the forewings in ants are longer than the hind wings, in termites they are of equal length.



Waist and wings distinguish termites...

Again, termites do not have larval and pupal stages like ants. The adults emerge directly from the egg. When infested timber is broken open and larval and

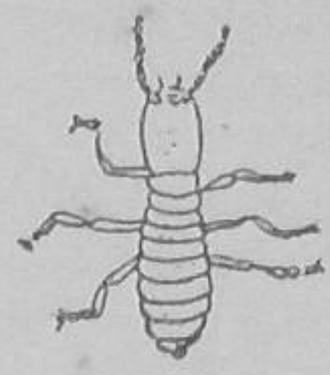


...from ants

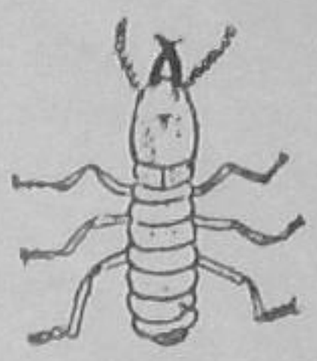
pupal cases are found, you may be sure that they are ants and not termites.

Like ants and bees, termites too have social castes, and every termite colony is a unit by itself. The castes are the reproductive, the worker and the soldier. The reproductive caste consists of the male and the female—called "king" and "queen"—which start as winged creatures. They are seen emerging from the ground in huge numbers early in the morning or late in the evening, immediately after the first rains. In the evenings, the insects swarm towards light. They shed their wings after a short time and pair off into soil crevices to found a new colony. The queen is about two inches long and is housed in a special chamber three to four feet deep in the soil. Under favourable conditions, the queen is capable of laying about 8,000 eggs per day.

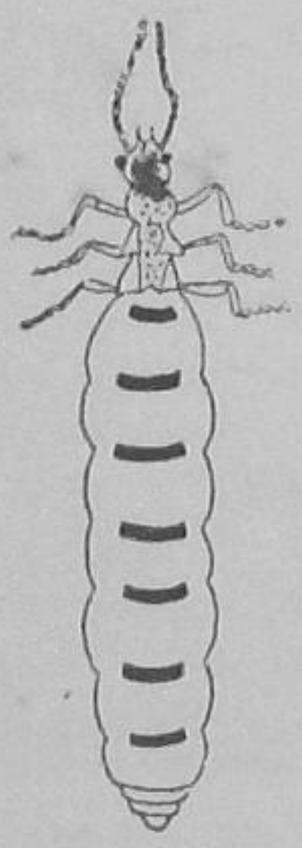
Winged adult



Worker



Soldier



Queen

King

The eggs laid by the queen develop into the familiar "workers" which form the largest number in a colony. It is this caste that undertakes all the work in the colony—constructing of tunnels, obtaining of food and feeding of the young, the king and the queen. Some of the eggs develop into strange-looking individuals with a hard, brownish head and two large jaws. These are the "soldiers," the defenders of the colony.

HOW TO CONTROL

The basic principle of termite control is placing a barrier between termites and the building, shrub or plant to be protected. This barrier must be complete, for termites are quick to divert towards unprotected avenues. A poison which penetrates into the soil as a gas and gives a sufficiently lethal coating to the food material and one which kills by contact the large number of workers coming up to the surface layers of the soil would be helpful in exterminating a colony. The destruction of the queen, though an effective measure, is difficult, for the queen is generally not traceable. In such cases, the holes should be stuffed with five per cent BHC powder.

A chemical barrier of "Dieldrin" has proved most satisfactory in termite control. Termites cannot live in or pass through "Dieldrin"-treated soils. "Dieldrin" contains not less than 85 per cent of the compound commonly abbreviated as HEOD (1, 2, 3, 4, 10, 10-hexachloro-6, 7, epoxy-1, 4, 4a, 5, 6, 7, 8, 8a-octahydro-1, 4-endo, exo-5, 8-dimethanonaphthalene), and not more than 15 per cent of the insecticidally-active related compounds. The dose of "Dieldrin" recommended for termites attacking growing trees, shrubs, ornamentals and lawns is an ounce of actual "Dieldrin" to 1,000 square feet. "Aldrin" at two to four pounds per acre, applied to the soil surface in the form of a low concentrate dust and worked in, gives an effective control.

A much cheaper method would be treating the soil with BHC and DDT, which is also reported to effectively protect the crop. Before sowing, five per cent BHC powder is evenly spread over the surface at the rate of 25 pounds per acre. This is then worked in. After about two weeks of germination, ten per cent DDT powder is mixed with the soil surrounding the crop.

Equally effective is the insecticide "Chlordane." Twenty to thirty pounds per acre of five per cent or ten to 15 pounds of ten per cent "Chlordane" dust are required. The chemical is mixed with the soil in the ratio of 1 :3, uniformly spread over the ground and then

CONTD. ON PAGE 22

Students' Gesture

One day every week, about a 100 students at the University of Leeds in England have a luncheon which consists only of a small bottle of milk and a bread roll —at a total cost of six pence. The additional two shillings which each student would normally spend on this meal are collected and used to help the people of the village of Rasulia, Hoshangabad district, Madhya Pradesh, where it is spent on the digging of wells and the development of agriculture. They have already sent £90 this year and hope to increase the sum to £150 by the year's end.

—*B.I.S.*

●

New Life To 30 Acres

How concerted efforts can turn "useless" acres into fertile ones has been demonstrated again by the students and staff of the Government Basic Institute at Dongargaon, M.P. For the second time, they have secured the highest yield of 640 maunds of corn amongst the educational institutions of the State. In addition, they harvested nine maunds of *til*, four maunds of *chana*, 45

Students and staff at work in the field

maunds of *alsi*, five maunds of *arhar* and 90 maunds of *tuera*—the total revenue being Rs. 15,000 as against an expenditure of Rs. 7,500.

The crop was raised on 30 acres of land which had been declared worthless by many. Superphosphate, ammonium sulphate and groundnut cake were used as manure, besides several cartloads of farmyard manure prepared by the students themselves.

—Shamsuddin

N.P. 824 For Delhi

Over 200 demonstration plots were laid out in as many Delhi villages by teams of helpers as part of the *Rabi* Campaign for increasing agricultural production. Photo shows a new wheat variety—*NP 824*, released for the first time in Delhi villages. This new variety promises higher yields and has become quite popular with the villagers.

* * *

A Mainland Chinese scientist reports he has found a way to use one plant and grow potatoes under the ground and tomatoes above the ground.

NEWS and PICTURES

Prime Minister At Suratgarh Farm

THE Prime Minister, Shri Jawaharlal Nehru, visited the Central Mechanised Farm at Suratgarh in Rajasthan last month. He is seen watching the Russian Harvester and Thresher in operation.

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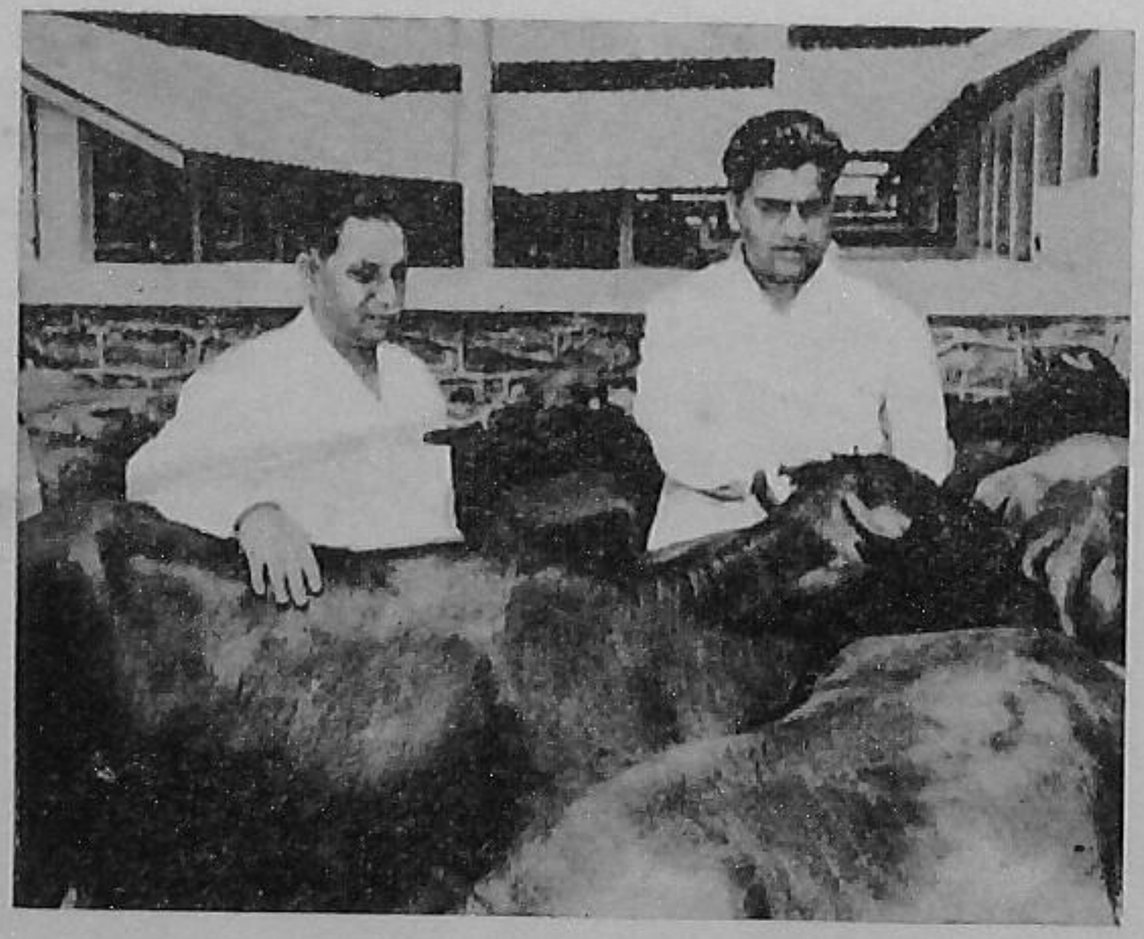


Good Cows For Cattle Breeders

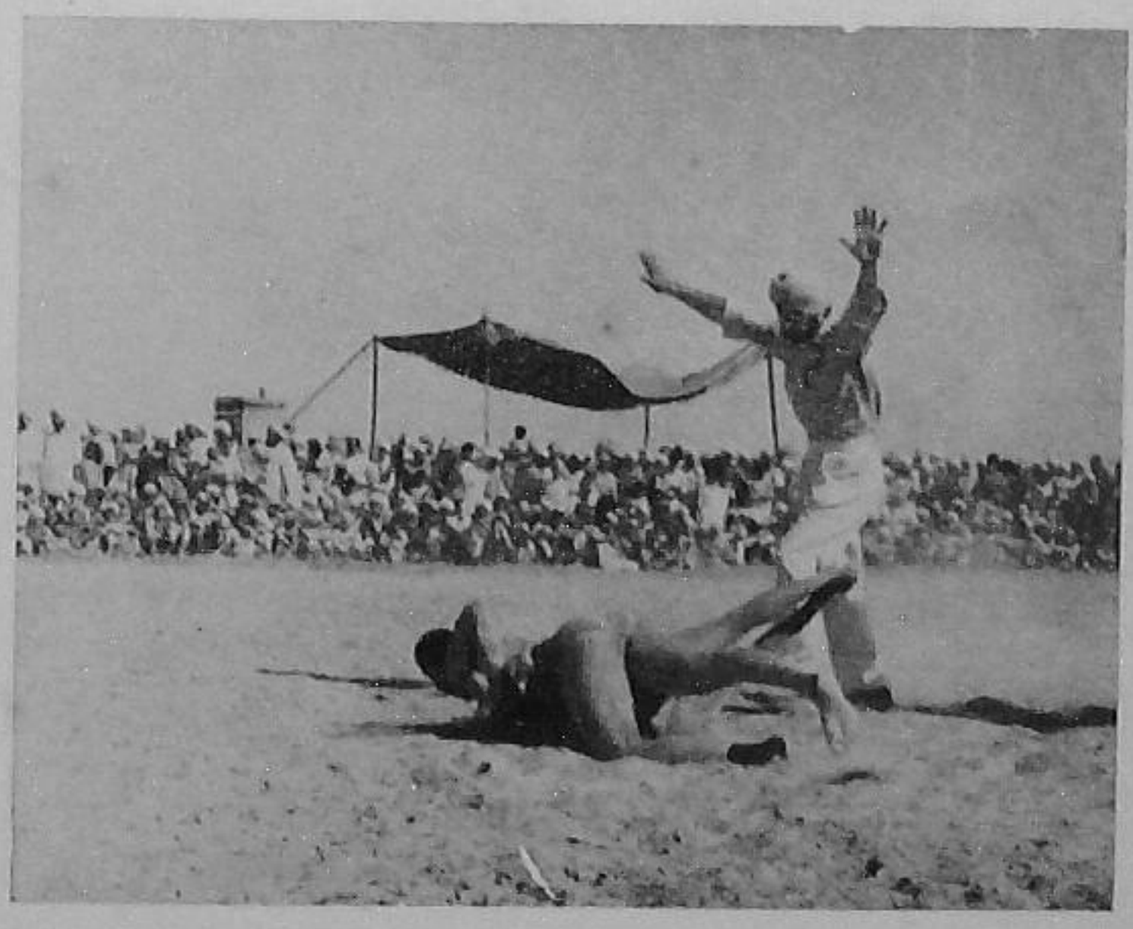
UNDER a new scheme sponsored by the Union Government, service co-operatives and bonafide cattle breeders will be presented with good-quality cows to improve their cattle.

Shri M. V. Krishnappa, Union Deputy Minister of Agriculture, inspecting the first herd of cows reared in Andhra Pradesh and Madras.

Jullundur 'Dehati' Mela

NEARLY two thousand villagers attended the Fourth Annual *Dehati* Mela and Sports recently sponsored by the Extension Section of the United Christian Schools, Jullundur City.

An outstanding feature of the *mela* was the puppet shows on village life organized by members of the staff and students. The displays of handloom products, village agricultural products, models, exhibits and demonstrations by the National Malaria Control Programme, the Public Health Services of the Punjab, the Department of Agriculture and the Department of Poultry and Animal Husbandry interested the visitors. Wrestling and *kabaddi* by young men from the surrounding villages proved to be quite exciting events.



Wrestling in progress at the Jullundur *Mela*

CONTINUED FROM PAGE 19

Termites

worked in. In a standing crop, spraying with 0.1 per cent "Chlordane" emulsion is recommended.

Irrigating the plots with crude oil or kerosene oil emulsion also checks termite infestation.

BUILDINGS AND TIMBER

The presence of termites is often indicated by swarms of winged black or brown adults suddenly appearing inside buildings or emerging from holes in the walls, floors or other parts of woodwork. Because subterranean termites live beneath the soil surface, the wood which rests on or near the ground is the first to be attacked.

Leftover timber and debris buried in the soil provide an ideal site for termite colonies. As the food supply in the colony dwindles, the workers enter the building directly or build small tunnels of clay up to the wooden supports of the building. These tunnels lead to the "ports of entry" under porches, through basements, corner pillars and cracks in the foundation.

The following measures should be adopted:

(i) Since termites must have moisture to survive and to build their mud tunnels, all leaks in plumbing and any other source of moisture near the foundation and the basement should be eliminated.

(ii) The soil which will be in contact with the building should be soaked with "Aldrin" or "Dieldrin" emulsion after the foundations are dug and before they are laid. The bottom and the sides of the foundation trench should be thoroughly wetted with the emulsion. The whole surface of the soil beneath the building and a strip three feet wide round it should be treated in the same way. All leftover timber and debris buried in the soil should be removed before the treatment.

The emulsion is prepared by adding a gallon of "Dieldrin" to 60 gallons of water. This gives a 0.3 per cent emulsion which should be applied at the rate of a gallon to ten square feet.

(iii) An oil solution of "Pentachlorphenol" should be painted over timber or woodwork.

(iv) The timber should be treated with an oil solution of copper naphthenate.

(v) Research at California University has now revealed that special, highly absorbent soils are more effective than insecticides in termite control. Such a soil can be sprayed over the timber or woodwork. The soil sticks to the bodies of termites when they try to crawl over thus-treated woodwork and absorbs the oily and sticky protective layer from them. As a result, the termites dry up and die within two to three hours.

New Sugarcane Brings Him Good Money

Chaudhuri Mam Chand and his fine crop

ONE hundred and five maunds of *gur* from an acre is a good recovery, and Chaudhuri Mam Chand of village Mitraon in the Najafgarh Block of Delhi is easily getting that much.

Mam Chand told me, when I met him recently, that he owed this to the Block authorities who had introduced the *Co. 312* variety of sugarcane into Delhi. "It not only gives excellent quality *gur*, but also a disease-free crop under Delhi conditions," he added. I at once remembered that in Uttar Pradesh and Bihar, *Co. 312* had been rejected on account of its high susceptibility to red rot.

Asked how he had raised his crop, Mam Chand supplied me the following details.

The field was ploughed ten to 12 times with a disc tiller, followed by planking. In December, trenches were made three feet apart, compost at 35 cartloads per acre applied in the trenches, and the trenches hoed four to five times to mix the compost well with the soil.

In early March, a maund per acre of superphosphate was mixed well with the soil in the trenches. Thereafter, healthy and disease-free two-budded setts—30,000 to an acre, were planted end-to-end, four inches deep in the rows. The setts were pre-soaked in water for early sprouting.

The first irrigation was given exactly a month after planting when ammonium sulphate at 2½ maunds per acre was also applied. Thereafter, 15 to 16 well irrigations, at intervals of ten to 12 days, were given. The crop was earthed with the *khurpa*. As the rains continued till late September and at times the downpour was quite heavy, the crop grew very tall, and was, therefore, propped and tied several times. Timely propping and earthing helped the crop maintain its stand, and it did not lodge.

The net profit from his four-acre crop came to Rs. 3,200, Mam Chand informed me.

—A.S. Sharma

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WINTER PEN TEMPERATURES

MORE RESEARCH data have been added to the accepted idea that egg production response to temperature change is almost immediate. Evidence also shows that eggs may be more economically produced when winter pen temperatures are kept around 40 to 50° F.

Work by F. A. Hays at the University of Massachusetts with three pure strains of Rhode Island Reds and crosses between strains showed when the monthly mean house temperature fell to 34° egg production declined to about 50 per cent from that of the preceding November. He concluded that pen temperatures should be maintained at about 40° in winter.

farm flashes

Gur blocks packed in Alkathene-lined fabrics do not liquefy or go down in quality during the monsoon. Alkathene-lined Hessian bags (28 inches × 19 inches) with bitumen bonding and double seams withstand rough handling best; in tests, they were dropped from heights of four and eight feet.

A machine developed by a British firm "dry-cleans" 1,500 eggs an hour, removing all dirt and slightly polishing the shells without affecting the natural protective coating; breakages are negligible.

When cigarette tobacco is topped along with the top few uneconomical leaves just when the inflorescence has emerged, the yield as well as the bright grades are increased by about 18 per cent.

Do not top plants the mature leaves of which look green. The side shoots or suckers which develop after topping can be suppressed by application of coconut oil to dormant buds in the top six axils of the plant.

The top leaves in flue-cured Virginia tobacco are usually green and cure badly. Dipping the stalks in water for five hours or more improves their grades and brings in an extra income of about Rs. 20 per acre.

Pit-curing imparts a characteristic flavour and softness of flesh to fish. The optimum period for the cure is two days for the gutted mackerel salted in a 1 : 5 ratio. Pit-curing consists in burying the fish, after salting, in mat-lined pits for varying periods; the fish is then marketed in a partially-dried condition without any further washing or drying.

Phosphate and micro-nutrients like boron and molybdenum when applied to *guar* increase the green matter yield by about 31 per cent. The texture of the soil is also improved.

During summer, cockerels should be removed from hens as soon as hatching eggs are no longer required. Egg production will not suffer, but eggs will keep fresh longer.

Green feed is invaluable to poultry during the hot, dry summer months. Enough vegetable wastes should be available from household trimmings or from a plot of vegetables grown for sale. If not, a special plot of green fodder such as lucerne or berseem may be grown for cutting. But by no means let the birds into the plot, for they will quickly kill the plants by picking out the crowns.

Goats not milking well often respond strikingly to increased water intake, with no other change in feeding or management. In hot weather, water requirement may be almost doubled ; goats then prefer a steady supply of cool, sparkingly fresh water. In winter, there is no better way to increase water consumption than by warming it.

Good gardening practices can cause flowers to have more nectar for bees. For this, the level of nitrogen is kept low enough to avoid excessive vegetative growth. The level of phosphorus should be sufficient to promote good flowering. Potassium should be sufficient to promote good flowering growth, but not high enough to limit flower production. Probably the best way to achieve proper fertilization is to use well-rotted compost which has been made with ground natural rock-phosphate.

As much as 59 per cent organic matter, 28 per cent nitrogen, 20 per cent phosphorus and 35 per cent potassium could be lost by wind erosion. The loss is greater in light-coloured sandy loams than in darker soils. Cover crops are the answer.

CONTD. FROM PAGE 16

Farming Elsewhere

Production and processing have been adapted to market requirements. More and more butter is pre-packed and marketed as "Lurpak"; more cheese and canned milk and cream are being produced; canned ham and dressed poultry both show a big expansion in production.

But once again in recent years Danish farmers have seen that it is only by co-operation and solidarity that they can make their influence felt. So the organizations have been strengthened in various ways, including the development of the agricultural press, and their leaders have brought greater energies to bear in other spheres which are just as important as improving quality and rationalizing production, namely, marketing forms and organization and the whole field of economic policy.

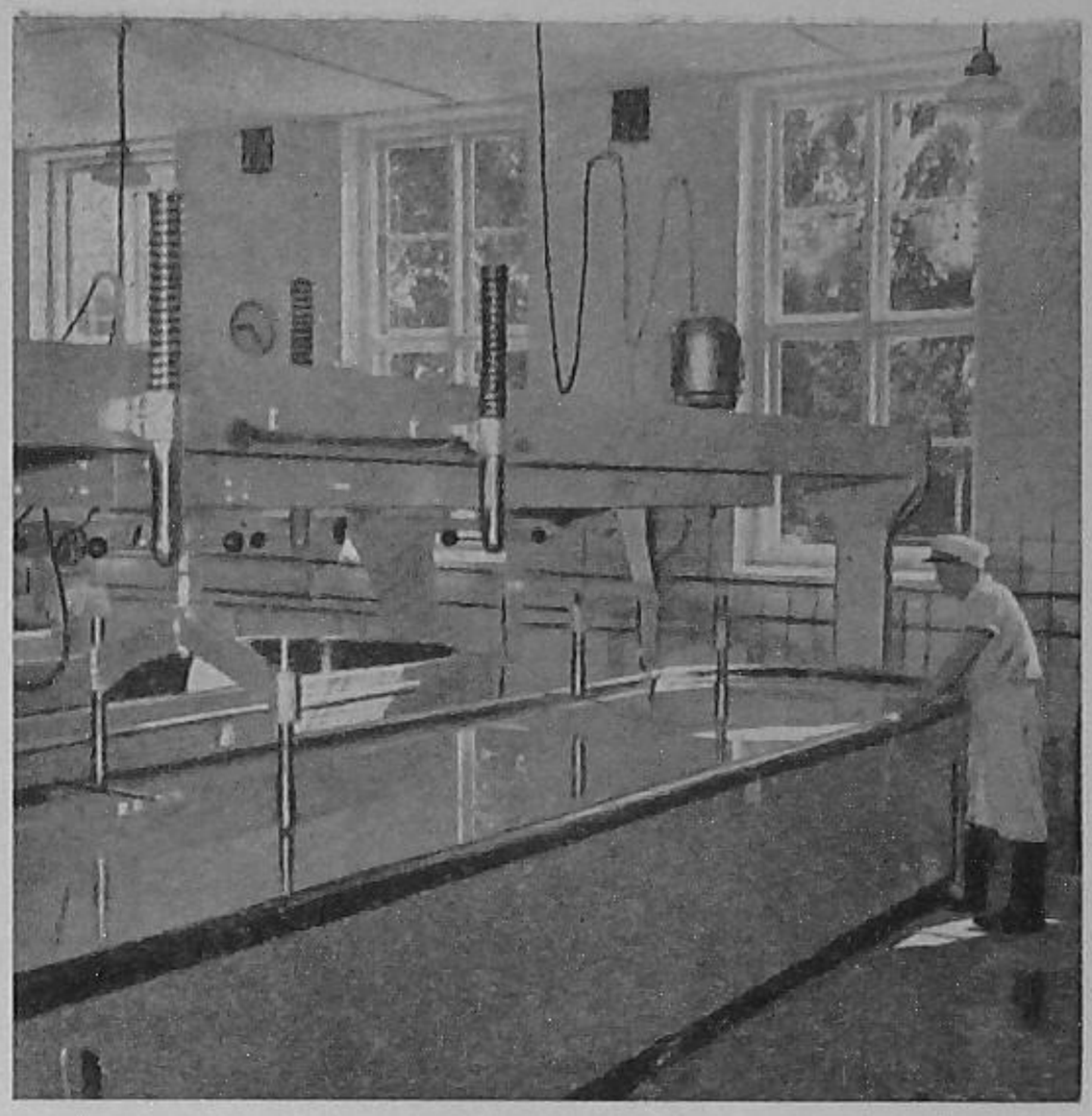
NEW EXPORT ORGANIZATIONS

Thus a milestone was reached when the farmers' organizations—the co-operative marketing associations in partnership with the agricultural and smallholder societies—assumed, in 1950, responsibility for export policy in the various branches of production after the abolition of the Government export boards which had centralized all exports during the pre-war, wartime and post-war emergencies.

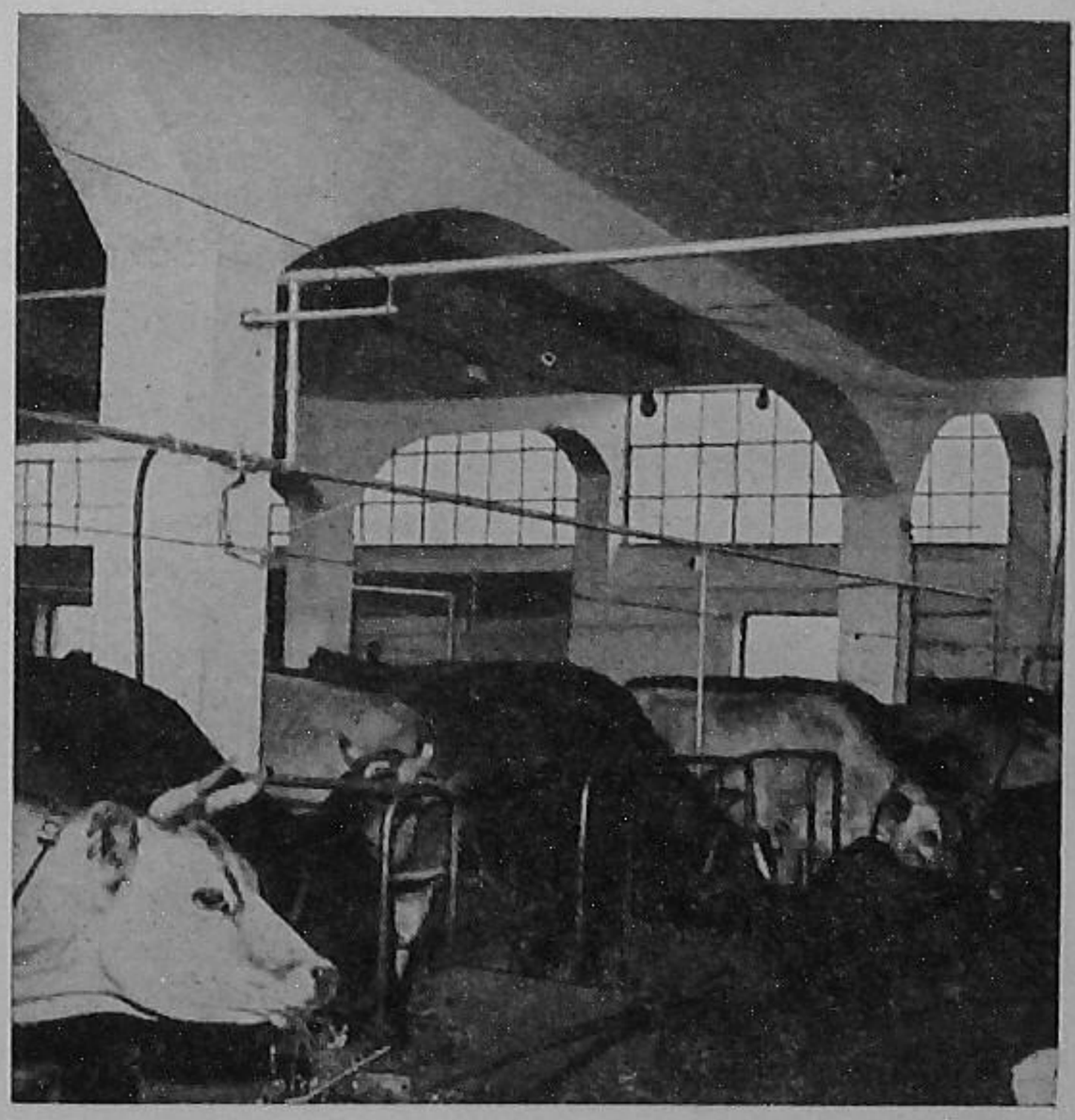
In the new export organizations, all of which work in close association with the Agricultural Council—the central organization of Danish farmers—the industry co-operated closely with private exporters also, and co-operation in the export of the principal commodities was admirable. To give support to the work of the export organizations and with a view to a further large-scale development of certain aspects of the work, the same organizations set up in 1958 the Agricultural Marketing Council and prevailed upon the Minister of Agriculture to pass a law which enables agricultural exports to be co-ordinated in spheres where co-operation has not already been voluntarily established.

Danish agriculture is a highly exposed industry. The years 1957-58 saw the collapse of the prices of all three of its principal commodities. During the last ten years, a gigantic effort to rationalize and cheapen production has helped only slightly, or not at all, increase farmers' earnings, owing to rising costs, wages and taxes. The investment returns have been poor, the profits less than in other industries.

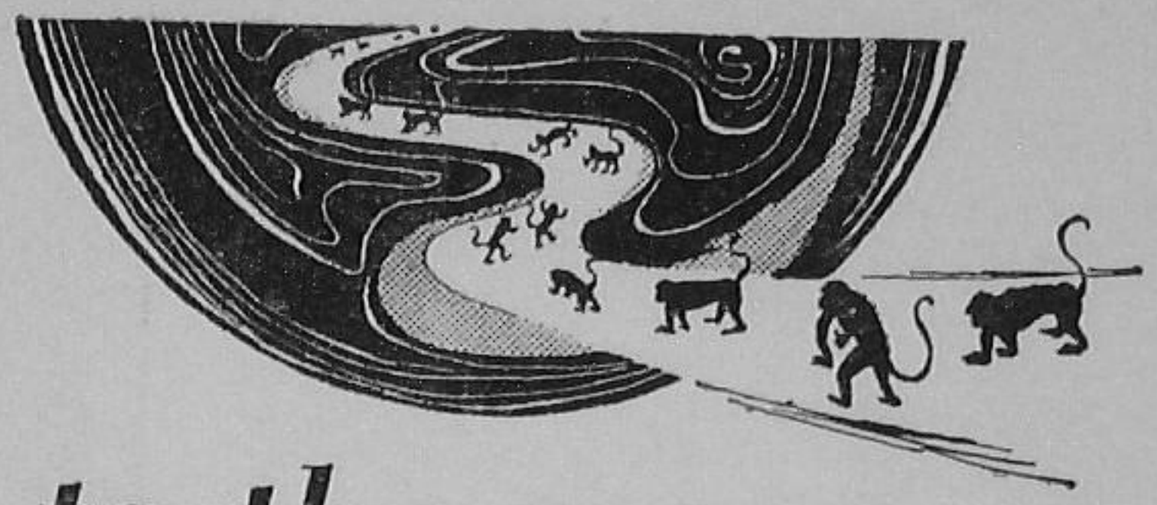
But for all that, and though the beloved horses are disappearing in face of the advancing tractor and more and more Danish farmers must be prepared to manage on their own without outside help, they work on steadily and efficiently. They are confident that the quality products of Danish agriculture will continue to be in demand at home and on the world market.



Machines turn out high-quality cheese



Cows are fed at most modern stalls



A way to the moon

(AN ANCIENT INDIAN TALE)

'Our parents are always saying that we are too young to know anything,' complained the young monkeys as they met in a forest. 'We are *not* too young,' they cried.

'And we shall prove that,' said their leader. 'We will form ourselves into a band, and then we can do just what we like.'

When the meeting was over, they all went home. That night, they didn't sleep beside their parents; they slept all by themselves, in groups, on the topmost branches of the trees by a lake.

Around midnight, one of the young monkeys woke up. Looking down from where he sat, he saw the bright moon shining on the lake below.

'Get up, get up, my friends!' he shouted. 'The moon has fallen into the lake. Let us go and pull it out before anyone else does so.'

'Oh! What a splendid idea!' cried his friends. 'How very famous we shall be!'

'The only way to reach that moon,' said the leader, 'is for us to form a chain.' So a long monkey-chain was formed, each monkey firmly grasping the tail of another. With a splash that resounded throughout the forest, the whole band, leader foremost, jumped plump! into the water—and there they drowned.

MORAL: Beware of the advice of those who merely *think* they know; listen to those who *really* know. Consider vanaspati. Leading authorities on health and nutrition agree that vanaspati is a wholesome food and a valuable addition to the Indian diet. DALDA Vanaspati—the brand trusted by millions of housewives—is made from pure vegetable oils, according to strict Government specifications. It is an all-purpose cooking medium and a rich source of energy-giving fats. DALDA contains extra nourishment, too! There are 700 International Units of Vitamin A added to every ounce plus 56 I. U. of Vitamin D. Yes, DALDA is more than a cooking medium—it's a food!

Punjab Farmers!

Lime The Acid Soil And See It Grow Better Crops

by

J.S. Kanwar

and

D.R. Bhumbla

EXPERIMENTS on the acid soils of Kangra district of the Punjab have now shown that the yield from wheat, maize and potato can be definitely increased by application of lime, alone or in combination with fertilizers.

In the Punjab, lime treatment of soils is practically unknown. Acid soils occur in the State in areas with an average annual rainfall of more than 50 inches, such as Kangra district and parts of Gurdaspur, Hoshiarpur and Patiala districts; some of the soils, especially in Palampur and Kangra *tehsils*, are highly acidic. Because of the increased use of artificial fertilizers like ammonium sulphate that leave acidic residue, maintaining of the lime status of the soil becomes all the more important.

In countries where acid soils are common, application of lime to improve yields is a normal practice.

The *p*H of a soil will tell you how alkaline or acidic it is. Soil with a *p*H below 7.0 is acidic and that with a *p*H above 7.0, alkaline. The lower the *p*H, the higher the acidity.

Most crops grow best in neutral soils. Plant growth is adversely affected in highly acidic or alkaline soils and low yields are the result. In acid soils, this is due to the reduced availability of some essential nutrients like phosphorus, calcium, magnesium and boron, and due to the availability in toxic amounts of others like manganese, iron and aluminium.

Plants, however, vary in their tolerance to acidity, as shown below :

Very tolerant *p*H 4.5 to 5.5	*Tolerant* *p*H 5.5 to 6.5	*Sensitive* *p*H 6.5 to 7.5	*Very sensitive* *p*H 7.0 to 8.0
Tea	Corn	Barley	Alfalfa
Lupins	Cucumber	Cabbage	Sugar-beet
Oats	Strawberry	Egg-plant	Celery
Blueberry	Potato	Cauliflower	Onion
Coffee	Vetch	Turnip	Pepper
Rubber	Soybeans	Wheat	Spinach
Timothy		Banana	
Tobacco		Groundnut	
Pineapple		Cotton	
		Vines	
		Stone fruits	

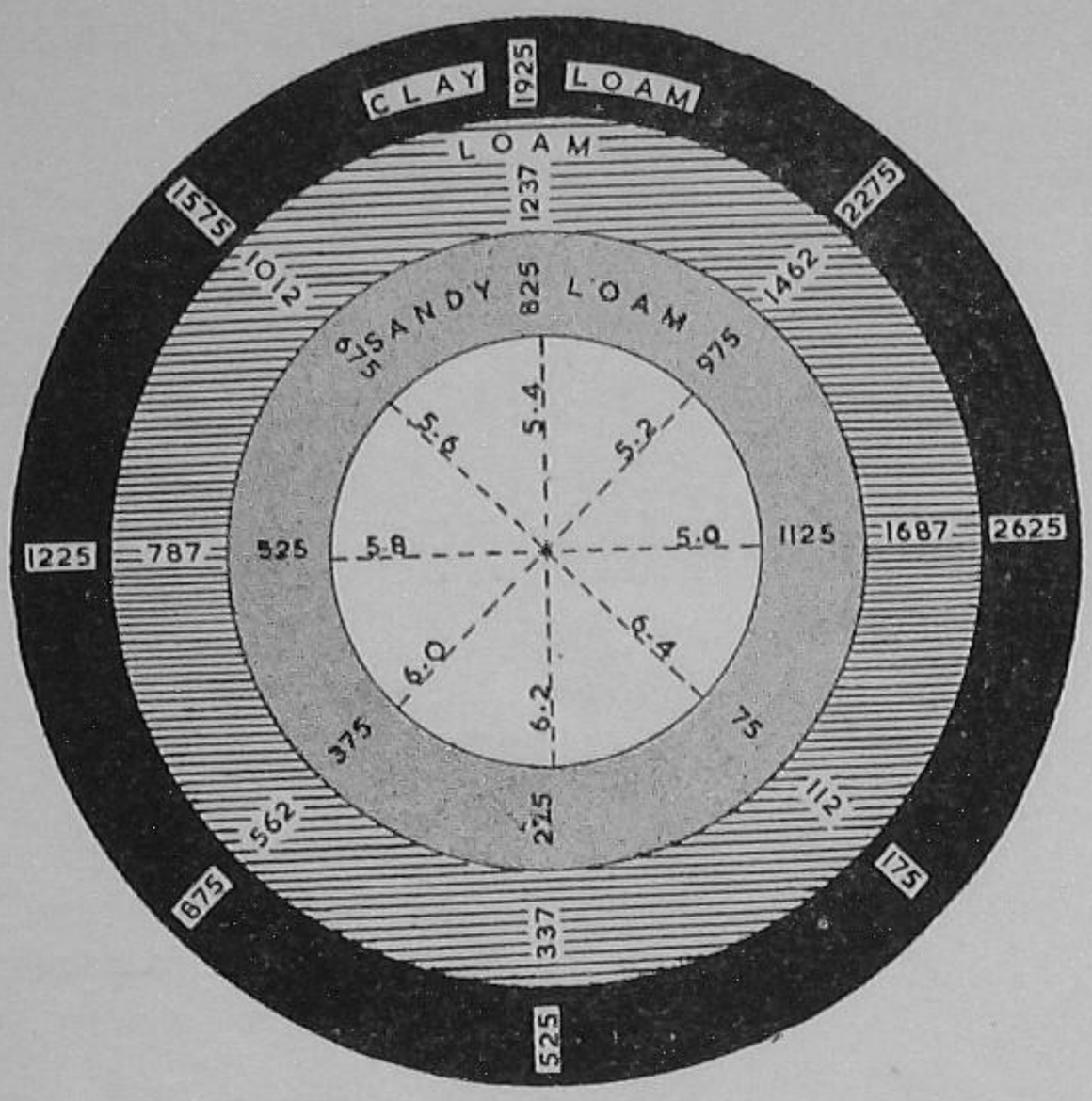
Liming benefits the soil by: reducing the acidity and increasing the availability of nutrients like phosphorus, calcium, magnesium and molybdenum; increasing the efficiency of fertilizers used on acid soils; decreasing the concentration of aluminium and manganese which may be present in toxic amounts; encouraging the growth of beneficial micro-organisms and stimulating biochemical processes; improving the soil structure.

HOW MUCH OF IT

The quantity of lime to be applied would depend upon the *p*H of the soil, its texture, buffering capacity, nature of clay, the organic matter content and the crops to be grown. The lower the *p*H of a soil, the more its lime needs. Soils with a low clay content will require less lime. Similarly, where the predominant clay is kaolinite, as in laterite and lateritic soils, the quantity of lime needed will be lower compared with soils having illite and montmorillonite types of clays. Soils with a high organic matter content may need more lime.

It is always safe to apply lime in quantities less than those indicated by laboratory tests, as overliming may lead to a deficiency of trace elements like manganese, zinc and iron; in some cases, excessive calcium may adversely affect the uptake of potassium and magnesium. Liming of soils with *p*H more than 6.5 is not beneficial. It is often desirable to apply lime to legumes and other crops that show the maximum response to it.

The liming requirements of a large number of acid soils of the Punjab have been determined in the laboratory and on that basis a ready-reckoner has been evolved. With this, you can know the lime requirements



This ready-reckoner tells you how much lime you need to apply your soil

of your soil in terms of limestone. Unslaked and slaked lime may also be used, if found cheaper. One hundred pounds of limestone have the same effect as 56 pounds of unslaked lime and 76 pounds of slaked lime. Pressmud, a waste product of sugar factories which contains about 70 to 80 per cent lime, is also a good liming material.

The liming material should be broadcast and then worked into the soil about a month before sowing. Fertilizers containing ammoniacal nitrogen or soluble phosphorus are not to be mixed with it, as its availability will then be reduced.

PUNJAB EXPERIMENTS

Given below are the results of liming experiments conducted in the Punjab.

MAIZE

Average yields of two experiments on farmers' fields during the *1957 kharif*; lime at 1,225 pounds per acre used

Treatment	*Grain yield in maunds per acre*	
	Unlimed	*Limed*
No fertilizer	9.50	14.15
Ammonium sulphate (50 pounds N)	10.97	17.78
Ammonium sulphate + superphosphate (50 pounds N + 50 pounds P_2O_5)	9.42	14.23
Superphosphate + potassium sulphate (50 pounds P_2O_5 +100 pounds K_2O)	11.25	16.75
Ammonium sulphate+superphosphate+ potassium sulphate (50 pounds N+50 pounds P_2O_5 +100 pounds K_2O)	14.95]	17.15

WHEAT

Agricultural Farm Kangra (1946-47), *p*H of the soil 5.8, lime at 270 pounds calcium carbonate per acre used

Treatment	*Grain yield in maunds per acre*	
	Unlimed	*Limed*
No fertilizer	18.75	—
Ammonium sulphate (20 pounds N)	18.35	24.37
Chilean nitrate (do.)	20.00	22.68
Ammonium sulphate (40 pounds N)	20.40	24.37

On farmers' fields (1954-55), a ton of pressmud per acre used.

Treatment	*Palampur* (*p*H 5.37)		*Rajpura* (*p*H 5.8)		*Patli* (*p*H 5.25)	
	Unlimed	*Limed*	*Unlimed*	*Limed*	*Unlimed*	*Limed*
No fertilizer	10.25	12.50	4.3	6.6	9.3	11.0
Ammonium sulphate (40 pounds N)	13.59	17.11	10.80	16.4	14.0	27.0
Ammonium sulphate + superphosphate (40 pounds N+40 pounds P_2O_5)	15.17	20.37	17.8	22.5	14.1	27.5

POTATO

Average yield of six experiments on farmers' fields during the 1957-58 *rabi*; *p*H less than 6.0

Treatment	*Yield in maunds per acre*	
	Unlimed	*Limed*
No fertilizer	63.52	96.22
Ammonium sulphate (100 pounds N)	116.85	144.66
Ammonium sulphate+superphosphate (100 pounds N+100 pounds P_2O_5)	138.47	166.05

SECOND ALL-INDIA MANGO SHOW

The Second All-India Mango Show for the Eastern Zone will be held at Ranji Stadium, Eden Gardens, Calcutta, from 11th to 14th June, 1959. Entries will be received up to 11th June, 1959, at Calcutta. For further particulars and copies of the Schedule apply to the Secretary, Indian Council of Agricultural Research, New Delhi, or the Horticulturist of your State.

This Locust Menace

by

K.B. Lal
Plant Protection Adviser to the Government of India
New Delhi

WHEN it is realized that a single female locust during her lifetime of about three to five months may give rise to over 500 hoppers, (young, wingles locusts); that a swarm of moderate density and a square mile in size may contain over a hundred million female locusts, that swarms about ten to 50 square miles in size have not been uncommon and the maximum size of a single swarm recorded in India has been 175 square miles, and that the progeny of even one moderately-sized swarm could give rise to scores, if not hundreds, of swarms, the stupendousness of the task of locust control becomes obvious.

It is not possible for any country to ensure a complete destruction of all the swarms received or even of major parts of them, though efforts towards this end are made with varying degrees of success; this is so because the swarms usually fly during day and settle down on the ground, bushes and trees during night, only to resume flight early the following morning. In practice, it is often difficult to get information about a settled swarm, collect personnel and supplies and conduct and complete the locust-killing operations, all during a night, especially when the swarms settle down in areas miles away from human habitation. Therefore, the major effort is directed towards destroying the locust hoppers, which are on the ground for four to six weeks, which move about rather slowly in large concentrations and cannot fly.

A typical locust breeding area in Bikaner

Following large-scale locust breeding and swarm movements in many parts of Africa, the Arabian peninsula and Iran, fears of a fresh locust plague in India this summer have revived. About half a dozen swarms crossed into Pakistan from the west during the second week of April, which, in all likelihood, will fly eastwards into the States of Bombay and Rajasthan and thereafter into Delhi, the Punjab, Madhya Pradesh and Uttar Pradesh.

If the swarms continue roaming about in the country, mass breeding may occur with the onset of the monsoon, giving rise to hordes of hoppers which, if not destroyed, will not only devour crops but also form new swarms. Meanwhile, more swarms may come into Pakistan from the west and eventually find their way into India. This situation may continue for some years.

DESERT LOCUST

Of the eight species of locusts that are of major economic importance in different parts of the world, the desert locust (so called because of its association with desert and semi-desert conditions and scientifically known as *Schistocerca gregaria* Forsk) is probably the most ancient in history, the most destructive and the most widespread in distribution. It is the

Locusts on the ground are destroyed by dusting

locust mentioned in the Bible as darkening the sky with its swarms and forming a part of the food of John, the Baptist.

Its capacity for damage arises from its vast numbers, great mobility and endurance in flights, high reproductive potential and ability to devour most kinds of vegetation, with a daily consumption of green food about equal in weight to that of its body during active life. It is endemically distributed over a vast desert area, stretching from Rajasthan in the east to the west coast of Africa. It is this area which provides conditions and locales for mass breeding, and from which swarms originate and fly over long distances. When not gregariously active, the desert locust lives and breeds as a solitary insect, as it does in the deserts of Rajasthan, and is harmless.

A certain periodicity has marked the plagues of the desert locust in India, authentic records of which exist since 1863. The last plague lasted from 1949 to 1955. However, the periodicity is only in respect of particular regions and there is hardly a period when the locust is not a plague somewhere in its vast distribution belt. Any one such plague in a region may have repercussions in areas far distant because of the long migratory flights of the locusts.

Usually, though not invariably, flying with the wind, the locusts are not mere, passive, air-borne aggregations of insects but are capable of maintaining their cohesion in a swarm against the dispersing effects of air currents and turbulences. Sixty-four territories or administrations and one-eighth of the world's population are affected by the plagues of the desert locust. It is not merely the value of crops destroyed by locusts that constitutes the major economics of the loss but the resulting scarcity of food and fodder, leading to malnutrition, diseases and death in men and cattle, reduction in the working capacity of both, and social evils and political dissatisfaction.

GOVERNMENT RESPONSIBILITY

Locust control is now well recognized to be a government responsibility and dependent for its success on international collaboration. Most countries in the desert locust belt have established national anties-locust organizations and many, including India, have occasionally joined together in common efforts for locust survey, intelligence and control. The Locust Warning Organization of the Government of India, established in 1939, operates in the desert areas of Rajasthan and Bombay States, covering a total of about 82,000 square miles, with a network of locust outposts, controlled from three main bases at Jodhpur, Bikaner and Palanpur.

The Organization maintains a fleet of motor vehicles, thousands of spraying and dusting machines and other control equipment and several hundred tons of locust insecticides, dispersed at about 30 different places in the desert areas. Two aeroplanes are also available for aerial spraying and dusting against the locusts. During periods of locust plagues, the Organization is expanded and strengthened.

INTERNATIONAL CO-OPERATION

International collaboration has been much in evidence, especially since 1953, when the Food and Agriculture Organisation of the United Nations sponsored a plan for international campaigns against the desert locust in the Arabian peninsula, which forms the central region for locust breeding, swarm formation and swarm migrations towards the east and west. The Arabian peninsula itself may receive swarms from both the directions. For the fifth year in succession, the Government of India have deputed a self-contained Anti-Locust Mission, with a total personnel of 22 and with locust insecticides and control equipment, to conduct operations in Saudi Arabia and Kuwait. Pakistan and some other countries have deputed similar missions which have taken up positions in various areas of the Arabian peninsula.

GREAT ADVANCES

During recent years, many advances have been made in the methods of locust control, which are now almost entirely based on the use of insecticides in poison

baits and for spraying and dusting locust concentrations. For a variety of reasons, the method of poison-baiting has long been given up in India. Application techniques have also been constantly improved. While both dusting and spraying machines, operated by hand or power, have been employed, the scarcity of water in the locust-infested areas has made dusting operations preferable. However, with the development of low-volume, power-operated sprayers, which reduced the required quantity of water to less than one-tenth, spraying acquired importance, because, apart from other reasons, transport, handling and storage costs on relatively small quantities of concentrated liquids are much less than on bulky dusting materials. Aircraft have been used in locust control in many countries for over the past 15 years, and in India since 1951.

Tractor-driven sprayers are important in anti-locust operations

Considerable research has been conducted on locusts in many countries during the past fifty years. In undivided India, the desert locust was studied in the laboratory and in the field from 1931 to 1939 under a scheme of the Indian (then Imperial) Council of Agricultural Research. Thereafter, some investigations have been continued, chiefly by the Government of India's Directorate of Plant Protection, Quarantine and Storage. In 1957, a Field Station for Investigations on Locusts was established at Bikaner under the Directorate. Research is also being undertaken and planned on an international basis, notably by the Anti-Locust Research Centre, London. Although much work has been done, many points in the behaviour of the desert locust and the dynamics of its population still remain obscure. Above all, control techniques need to be constantly improved and perfected.

KUDZU

EXCELS AS FODDER

by

F. G. Nagasundara
Government Agricultural Farm
Kudige, Coorg

OF the 52 fodder crops under trial at the Kudige Government Agricultural Farm in Coorg, Kudzu has proved to be outstanding. It is not only rich in protein, calcium and phosphorus, and, therefore, excellent for improving the milk yield of cattle, but also has the following additional advantages:

it can be grown without irrigation on waste lands, hill slopes, etc., by a farmer of ordinary means;

it provides the only green fodder during the dry months of April and May in the absence of irrigation;

its deep roots and dense foliage check erosion, and in fact it is best suited for sloping lands;

its withering vine and leaf in winter enrich the soil with organic matter to the extent of a ton per acre.

Kudzu is a native of Japan. It is a perennial legume and is used extensively as a cover crop and for soil conservation. A few varieties are indigenous to India also.

Kudzu is a deep-rooted crop, producing a number of wiry branches. It spreads like a runner, striking roots at nodes. A branch may at times reach 30 to 50 feet in length. The adventitious roots at the nodes fix the plant firmly in the soil and also help in its nutrition. The portions of the vine with rooted nodes grow independently even if severed from the mother plant. Thus, in a short time the plant establishes itself over an extensive area. The branches bear thick foliage, the leaves being soft, succulent and much relished by cattle.

Kudzu grows in almost all types of soils except in poorly drained and water-logged areas. A low to moderate rainfall is helpful in its growth. All the same, it grows extensively in high-rainfall areas like Assam, too.

There are four species of kudzu, viz., *Pueraria thumbergiana*, *P. hirsuta*, *P. phaseoloides* and *P. tuberosa*. Of the two varieties, viz., *P. hirsuta* and *P. phaseoloides*—tried at the Farm, the former gave a poor performance, although it has proved quite successful in the U.S.A. *P. phaseoloides* is particularly suited for tropical belts, as shown by its satisfactory performance at the Farm.

In the trials, the land was ploughed once or twice before planting. Pits one foot × one foot × one foot were then dug in rows five feet apart, the distance between the pits also being the same. A basketful of compost was applied to each pit. Seedlings raised from seeds or basket plants propagated vegetatively were planted in July-August.

Some plots were irrigated and the others rain-fed. The crop was ready for the first cutting three months after planting. With irrigation, five to six cuttings a year, with a total yield of 300 maunds per acre, were obtained; from rain-fed plots, only three cuttings, amounting to 200 maunds, could be taken.

Growth in winter. During winter, when the mean temperature in this region is about 65°F, it was observed that the rain-fed kudzu withered, its fallen leaves enriching the soil. In the irrigated crop, however, growth became stunted, the leaves shrank in size, giving a wilted appearance; the growth improved April onwards. Both the irrigated and the rain-fed kudzu started establishing vines almost simultaneously as soon as the March-April showers were received, but in the former, regeneration was 15 to 20 days earlier.

AS PASTURE

As a pure pasture, kudzu is raised either on thoroughly ploughed land or grassland. It takes three years to establish on grassland and two years on ploughed land. When it is fully established, cattle are allowed to graze. The basket plants are planted at 20 feet between rows as well as plants.

Kudzu was tried as pasture at the Farm on a grassland. It established itself well and grew luxuriantly. Cattle could graze on it just after six months. This method has the advantage that the grass and the legume both contribute to the health of the animals.

The reaction of kudzu to grazing, including the length and interval of grazing, trampling, as also the total strength of cattle per acre, are still under study.

VEGETATIVE PROPAGATION

Kudzu is a shy seeder and difficult to establish by seed. However, it can be propagated with ease vegetatively. The method used at the Farm is layering.

Bamboo baskets nine inches high and three inches in diameter are treated with copper sulphate solution and filled with ordinary earth, jungle soil and sand mixed in the proportion of 1 : 1 : 1. Mature vines of *P. phaseoloides* are selected, and one of the nodes is inserted into the soil in the basket. More soil mixture is added and CONTD. ON PAGE 40

MICRO-ORGANISMS and SOIL FERTILITY

by
P. C. Raheja

MANY types of organisms appear to survive in the soil for long periods though they remain inactive. Several of these micro-organisms affect the supply of major and minor nutrients to plants. A large number of heterotrophic organisms are able to satisfy their nutrient requirements exclusively from inorganic sources provided organic sources of carbon and energy are available. Other such organisms are able to utilize organic sources of nitrogen, phosphorus, sulphur and other elements. The mechanism of uptake of nutrient elements in plants and micro-organisms is essentially similar.

Besides, there is a limited number of specific inorganic transformations of nutritional importance which are carried out by autotrophic organisms. "Elements such as nitrogen, sulphur, and iron in various forms are involved." Furthermore, the solubility of other elements from the minerals into the soil solution is increased due to products of the metabolism of micro-organisms, such as evolution of CO_2. The increase of its concentration may release more inorganic mineral phosphorus for plant use. However, the direct and indirect effects of the microbial activity on nutrient availability do not rival in importance those transformations that are involved in the decomposition of organic matter and plant residues.

Fungi assimilate more of substrate carbon than do bacteria. The former, in consequence, have a higher demand for nitrogen for protein synthesis than the latter. Thus, compared to fungi, bacteria play a more important part in nitrogen transformation. At a carbon-nitrogen ratio of 20 :1, the microbial tissue is no longer required by bacteria, for a synthesis of new microbial protein and ammonia, in consequence, begins to appear, which is either adsorbed on the clay particles or escapes as gaseous nitrogen. Besides nitrogen, other elements are also immobilized in an organic or inorganic form in the tissues of soil organisms and become available on the decomposition of tissues. "Inorganic phosphates may be incorporated in nucleic acid and phospholipids, sulphates in sulphur containing amino-acids and sulphonic esters, minor elements such boron and manganese may be retained in combination not at present known." This microbial immobilization is an important step in transformations affecting the availability of nutrients.

The following micro-organisms are involved in nutrient availability.

Bacteria

(*i*) Nitrogen-fixing bacteria;
(*ii*) Nodule bacteria
(*iii*) Phosphobacterium

Fungi

(*i*) Heterotrophic—in oxidation processes
(*ii*) Autotrophic—in reduction process

These mostly take part in biological transformations.

Algae

(*i*) Blue-green algae—Direct
(*ii*) Green algae
(*iii*) Yellow-green algae
} Indirect by incorporation of organic matter and keeping soils and rhizosphere well aerated

Inverteberates

For excretion of proteinous compounds and other simpler organic compounds.

A brief account of their mode of action in making plant nutrients available is given below.

NITROGEN-FIXING BACTERIA

Azotobacter. The *Azotobacter* group of bacteria were found associated with the fixation of nitrogen in the soil in 1901. These bacteria occur in the vicinity

of roots especially in conjunction with *B. radiobacter*. These are normally more active in cropped than virgin soils. The bulk of the available evidence indicates that *Azotobacter* do not appear more frequently in the rhizosphere than in the soil away from roots.

But a number of Soviet scientists have claimed, in the past two decades, that yields of non-leguminous crops are superior when seeds or seedlings are inoculated with *Azotobacter*. By 1942, five million acres in the U.S.S.R. had been field-inoculated with this bacterium and it is estimated to have trebled the yields. Outside the U.S.S.R., however, only negative results have been achieved.

Azotobacter has very definite nutritional needs. It needs simple compounds such as sugars and lower fatty acids and simple aromatic acids to flourish. Besides, it requires Mo, Ca,C, Sr and Fe. The concentration of readily available nitrogen should be low. The excreted compounds are protein-like substances of varying degrees of complexity; a fraction (up to ten per cent) may be ammoniacal nitrogen. Most of this nitrogen is taken up by other bacteria.

The results of nitrogen-fixation reported in literature are given below.

Nitrogen fixed by *Azotobacter chroococcum* with different sources of energy (After Waksman 1952)

Mgm. of nitrogen fixed per 100 gm. of carbon

Material	*Nitrogen fixed (mgm.)*	*Material*	*Nitrogen fixed (mgm.)*
Pine needles	57.3	Plant roots and stubble	596.8
Oak leaves	126.9	Lupins	711.5
Maple leaves	89.5	Alfalfa	319.5
Wheat straw	325.4	Clover	1237.9
Corn stover	280.3	Glucose	1456.5

The above data show that an easily utilizable source of energy is a very important factor for *Azotobacter*. Five species of *Azotobacter* so far recognized are *chroococcum*, *beijerinckii*, *agilis*, *indicum* and *vineland*.

Clostridia. These appear to be more widespread than *Azotobacter*. Besides, all the *Clostridia* strains do not possess the same power of nitrogen-fixation. These are of importance in forest soils.

ALGAE

Soil algae aid in plant growth by adding organic matter, binding the soil particles on the surface, improving aeration of swampy soils and fixing atmospheric nitrogen. In these beneficial activities, blue-green, yellow-green, diatoms and green algae play a very prominent role.

In nitrogen-fixation, blue-green algae of the family Nosto-coccaceae, including members of the genera *Nostoc*, *Anabaena*, *Aulosira* and *Cylindro-spermun*, possess the power of fixing atmospheric nitrogen. They can fix nitrogen in the dark. The enzyme system in blue-green algae and *Azotobacter* appears to be similar. They probably play an important role in nitrogen-fixation in rice soils. On desert soils, sometimes the algal crusts consist of blue-green algae. These have not been found to fix nitrogen in temperate regions. Thus, in a hot damp climate they are agriculturally very important.

This has been confirmed by recent observations on Delhi soils. Seventeen species of blue-green algae were found in a soil depth ranging from 0 to 12 inches. Most of these are capable of fixing atmospheric nitrogen. From these observations it is concluded: "The recuperation of nitrogen in these soils is perhaps predominantly an algal process. By increasing and strengthening the local blue-green algal flora of a given habitat, it may be possible to increase the fertility of these soils." The experimental work in Bihar at first established that the blue-green algae fix about 13 pounds per acre of nitrogen. Later work indicates the possibility of fixing up to 40 pounds per acre by inoculating with suitable strains.

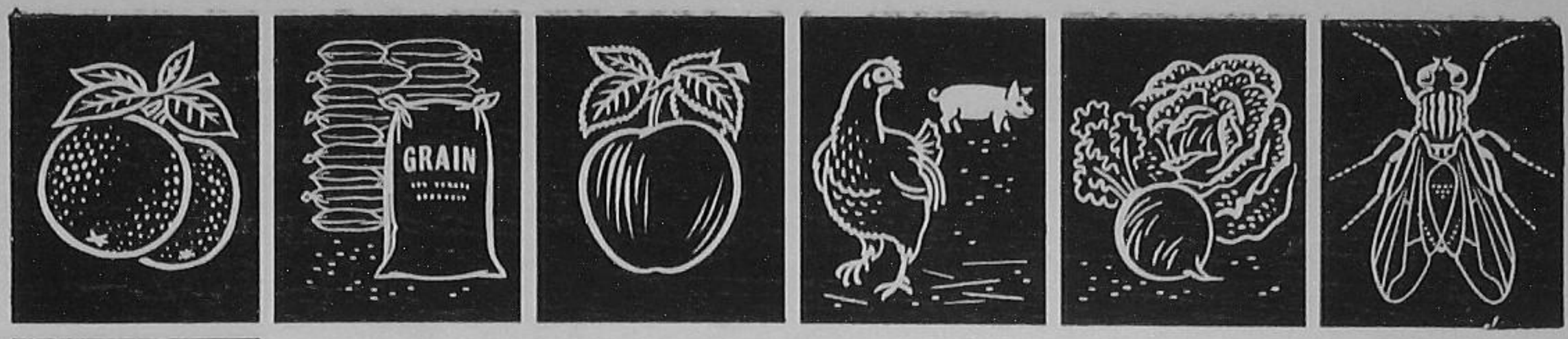
LEGUME BACTERIA

The most important cross inoculation group of nodule bacteria are:

1. Lucerne or sweet clover (*Medicago* and *Melilotus*)
2. Clover (*Trifolium*)
3. Pea and vetch (*Pisum*, *Lathyrus*, *Vicia* and *Lens*)
4. Soybean (*Glycine*)
5. Lupins and serradella (*Lupins* and *Ornithopus*)
6. A few species of *Phaseolus—vulgaris*, *coccineus* and *augustifolia*.
7. A large ill-defined group containing most other crop legumes such as cowpeas, groundnut, lespedeza and the other species of *Phaseolus*.

The strains of bacteria that produce nodules also affect their size, longevity and the amount of nitrogen fixed. The effective strains produce fewer and larger nodules than ineffective strains. Strains producing nodules may not necessarily fix nitrogen. It has been shown that there is gene specificity in relation to individual bacterial strains. Lack of the proper strain of nodule bacteria may limit the growth of legumes.

The amount of nitrogen fixed by bacteria depends upon the variety of legume, strain of bacteria and the



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conditions for nitrogen-fixation, including the supply of other nutrients to the crop essential for their optimum growth. The green manures return from 40 to 80 pounds of nitrogen per acre. The root nodules may excrete ten to 40 pounds nitrogen per acre. Clovers and lucerne may add about 150 to 200 pounds per acre of nitrogen annually to the soil. Some leguminous crops such as soybean and field bean enrich the soil only if green manured.

PHOSPHOBACTERIUM

Some of the bacteria that take part in the assimilation of inorganic phosphorus from the soil have been cultured from the soil. Two of the cultures were separately obtained from the U.S.S.R. and Yugoslavia. Recently, an Indian culture has been isolated. These cultures were applied to the berseem field without and with rock phosphate. The results have shown that the phosphorus uptake was increased and it beneficially influenced the berseem yield. Further work has been taken up on different soil types and on cereal and other legume crops.

TRANSFORMATIONS THROUGH MICRO-ORGANISMS

Nitrogen cycle. This is primarily a biological cycle. The ammonia is released from microbial tissues or microbial residues. The microflora in the soil live on the organic matter which is the sole source of nitrogen in the soil. Under aerobic conditions, ammonia forms their sole important nitrogen excretion product. When the oxygen supply is restricted amines may also be produced. These micro-organisms are present in abundance, provided decomposable organic matter is available in large quantities.

The transformation of ammonia into nitrate is brought about by the process of nitrification, which again is a biological process. At first, ammonia is oxidized to nitrite by *Nitrosomonas* bacteria. Furthermore, nitrate is produced by *Nitrobacter* bacteria from nitrite in the second step. The ammonia is adsorbed on the particles so that microbial oxidation of exchangeable ammonium ions occurs on the surface of the soil particles in the presence of a good supply of Ca and PO_4 and when there is a proper balance of the trace elements iron, copper and zinc. Autotrophic bacteria obtain their energy in the process of oxidation of ammonia and nitrite. Normally, the process of nitrite oxidation proceeds faster than nitrite production, so that the nitrite level in the soils is usually much lower than that of nitrates or ammonia.

Phosphorus cycle. It is now recognized that organic phosphorus transformation in the soil is of real significance in relation to the supply of phosphorus to the crop. The organic phosphorus content of soils varies from 18 to 52 per cent of total phosphorus and is correlated with the carbon content. Most of the organic phosphorus in microbial tissues is in the form of nucleic acids and phosphoproteins. In some plant tissues, and notably in cereal crop residues, organic phosphorus occurs also in phytin, a compound not believed to be synthesized by micro-organisms. The mineralization of nucleic acid phosphorus is controlled primarily by the nitrogen status of the system and this phase of the phosphorus cycle may often be subservient to the nitrogen cycle, because for protein synthesis a quantitative relationship between the nitrogen and phosphorus requirement of micro-organisms exists. The ash of microbial protoplasm may contain up to 25 per cent phosphorus.

Sulphur cycle. Like phosphorus, sulphur is also involved in organic combination in the proteins of plant and microbial tissues. The sulphur and the phosphorus contents of organic matter are of the same magnitude. Through the agency of certain autotrophic organisms, the organic sulphur may undergo a series of oxidative reactions which terminate in sulphate. The normal oxidative biological reactions bring this about. Sulphur in organic matter exists in amino-acids, cystine and cysteine, derived from proteins, which it appears, are resistant to hydrolysis.

Cationic elements. Since potassium and calcium have strong cationic properties, such elements do not undergo transformations on a large scale. They are, however, immobilized by micro-organisms when they are present in living tissues. Manganese is another element which undergoes biological oxidation. It is oxidized by heterotrophic organisms to manganic oxide and manganese dioxide which are unavailable to plants. These are microbially reduced when manganese becomes available for the plants. Iron also may undergo oxidative or reductive transformations in the soils. Autotrophic organisms are capable of oxidizing iron from the organic tissues. Copper, zinc, and molybdenum similarly undergo transformations which are brought about by micro-organisms. Available boron has been shown to be correlated with the organic matter content of soils. But very little is known as to the nature of transformations that may be undergone in the soil by boron, or aluminium, and silicon. On the whole, the role of micro-organisms in relation to micro-nutrient supply in the soils has not yet been fully understood.

It may be concluded that the micro-organisms in the soil play an important part in releasing plant nutrients for uptake by crops. This is brought about by

fixation and transformation processes.

The fixation of nitrogen takes place through the agency of blue-green algae, *Azotobacter*, *Clostridia* and by transformation of organic nitrogen through heterotrophic and autotrophic bacteria. Besides, nodule bacteria are a rich source of symbiotic nitrogen fixation. Legumes have so far been included in crop rotations in India to replenish the depleted soil nitrogen. Although large claims have been made in the U.S.S.R. that yields of cereals can be substantially increased by inoculation with *Azotobacter*, evidence from other sources does not support it. Work in India has established that blue-green algae fix about 13 pounds per acre of nitrogen and species of *Anabaena* predominate in this process. Inoculation of soils in Japan with selected strains of blue-green algae appears to show promise.

Phosphorus in organic combination exists from 18 to 52 per cent in different soils and is correlated to the carbon content of the soil. This is transformed by microbial activity. Recently, phosphobacteriums have been isolated in various countries and their preliminary trials in India have shown some promise.

Micro-organisms play an important role in the transformation of micro-nutrients and other elements. Their exact role has not yet been determined.

FUTURE LINES OF INVESTIGATION

Strains of blue-green algae suitable for various soil types and in relation to climatic regions should be selected. Methods of culture for multiplication of algae on a mass scale should be worked out. Conditions under which the inoculation is most effective should be determined in different regions of the country for paddy soils, uplands where the rainfall exceeds 25 inches and desert soils.

The strains of nodule bacteria which are effective nitrogen-fixers in various legumes should be selected. So far, little systematic attention has been paid to this aspect. The bacteriophages which affect the growth of bacteria should be studied.

Work on phosphobacterium should be intensified.

The research in microbiology to study such phenomena as gene specificity in relation to nodule bacteria, conditions under which nitrite production can be accelerated to correspond to nitrite oxidation, organisms concerned in oxidation and reduction of micronutrients and major nutrients such as sulphur, phosphorus, potassium, and calcium should be organized on a regional basis.

Radioactive tracers such as N^{15}, P^{32}, S^{35}, Zn^{65}, K^{42}, Ca^{45} and C^{14} should be used to gain a better understanding of organic matter transformations in different soils of the country.

CONTD. FROM PAGE 33

Kudzu

pressed firmly. A ten-foot vine can be used for three baskets. Layering should be taken up in July or August. In the absence of rain, frequent pot-watering has to be done.

In about 20 or 30 days, the roots get established. The basket plants are then ready for separating from the mother plant. They are separated by cutting and then planted wherever desired. They should be planted within two days of separation or else they may not survive. If they are transported long distances for planting, they should be shaded properly. After planting, the plants should be watered on alternate days for at least 15 days if there is no rain. At the farm, 80 per cent of plants propagated this way survived.

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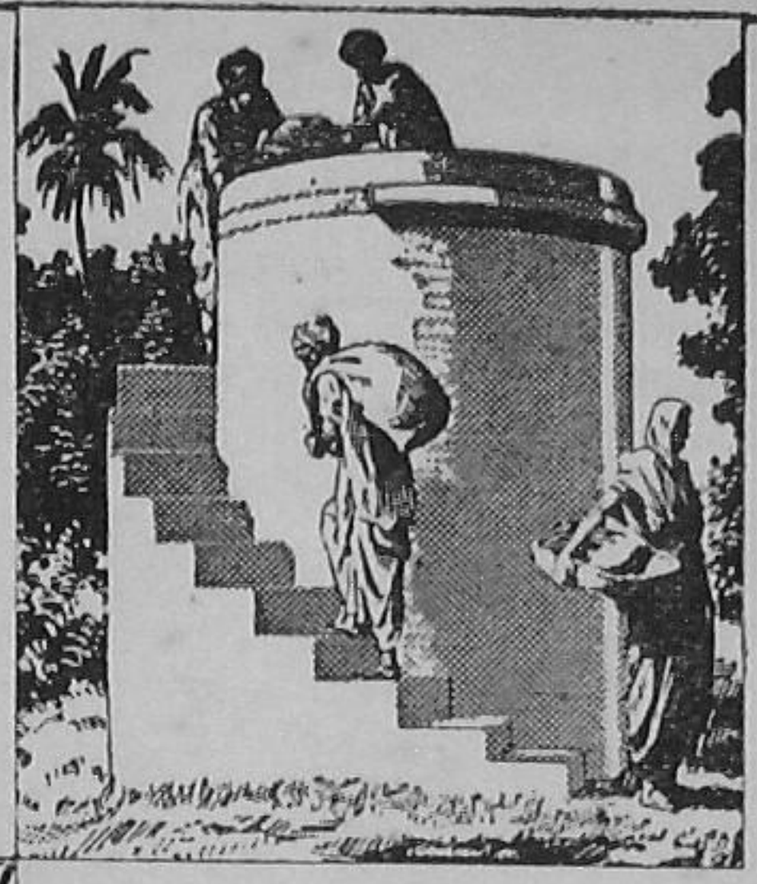

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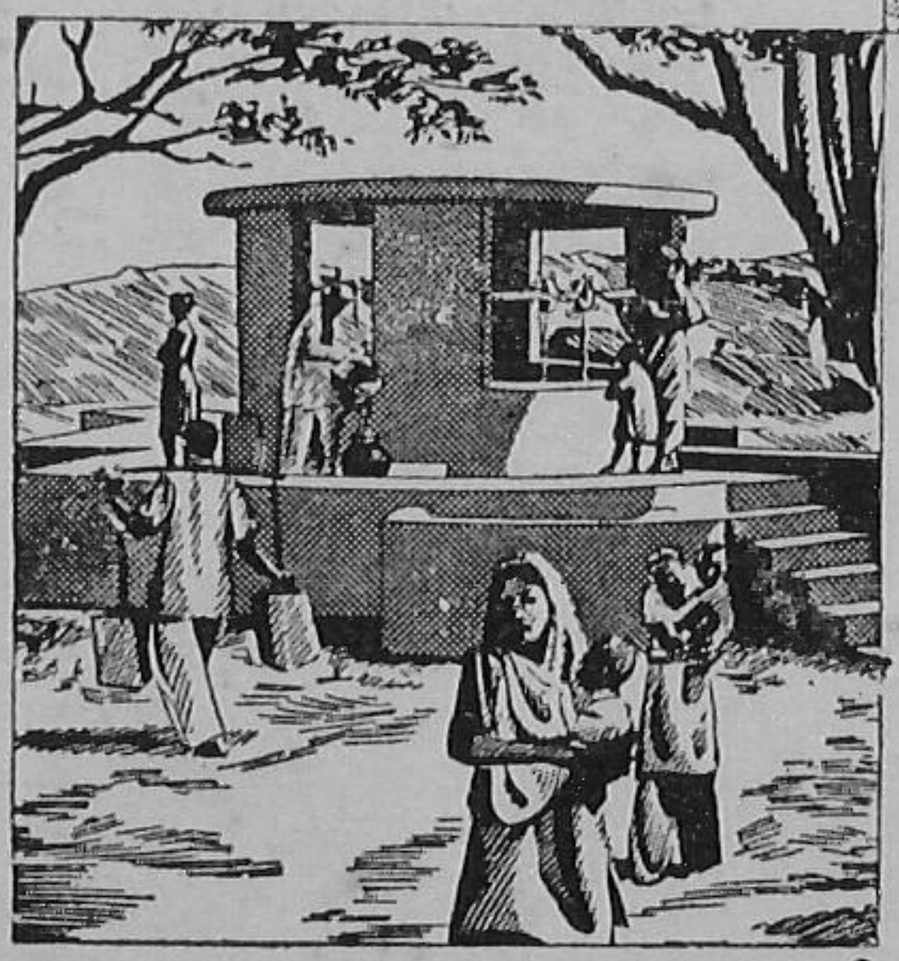

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