THE MANUFACTURE OF HUMUS BY THE INDORE PROCESS

By

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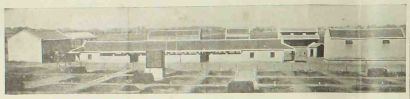
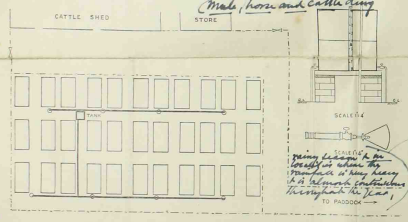
THE advantage of a continuous supply of leaf mould (humus) for such crops as tea, coffee, sugar, ~~cotton~~ and ~~indigo~~ needs no argument. It is well known to every planter.

The object of this article is to draw the attention of the plantation industries of the East to a composting system—known as the Indore process—by which the waste products of the estate can,



The Institute at Indore.

at small cost, be converted into valuable humus. This method, the outcome of 25 years' work, was perfected at the Institute of Plant Industry, Indore, Central India, and is described by Messrs. Howard and Wad in *The Waste Products of Agriculture; Their Utilisation as Humus*, published in 1931 by the Oxford University Press, Bombay.



Plan of Composting Area.

The Indore method has been taken up at many centres all over the world, including most of the coffee estates in Kenya and Tanganyika and many of the tea estates in India and Ceylon. It has proved to be a thoroughly elastic method, suitable for a variety of climates, for a wide range of crops and capable of being carried out by the most primitive types of labour. Readers of this journal interested in the process can obtain copies of an illustrated paper of instructions on application to the writer of this article to 14, Liskeard Gardens, Blackheath, London, S.E. 3.

The Composting Area.

The first requirement of the process is an area of land, conveniently situated for supervision. At Indore this consists of 33 pits, each 30 ft. by 14 ft. and 2 ft. deep, with sloping sides, arranged for the easy passage of loaded carts. The pits are in pairs, with a space 12 ft. wide between each pair. Water is provided by a tank, holding 3,200 gallons, 4 ft. above the ground to provide the necessary head. The water is led by 1.5 in. pipes from the tank to eight taps, to which the armoured hose (fitted with a suitable nozzle) can be screwed. Each tap serves six pits. The arrangement will be clear from Figs. 1 and 2.

Waste Products.

The materials needed for making humus are the following :—

(1) **Mixed Plant Residues.**—All available vegetable wastes from the estate—such as weeds, green-manure, cane trash, fallen leaves, light prunings, ~~water hyacinth~~, trimmings from roadsides and hedges, ~~green-manure~~ wood shavings, saw-dust, waste paper, old gunny bags and so forth—are collected and stacked. All hard woody materials are either crushed (by being placed on the estate roads and broken up by the traffic) or cut into short lengths by a chaff cutter. *All fresh green materials—such as weeds, green-manure and water hyacinth—must be withered before stacking.* To ensure even mixture, the stacked material is removed from one end of the stack either to the pits direct or as bedding for the ~~main-manure~~ stacks, horses & cattle.

(2) ~~Cattle Bedding and Horse Dung~~ (including all soiled bedding from under the animals).

(3) **Urine Earth.**—The earth under the animals should be dug out to a depth of six inches every three months, ~~powdered in a mortar mill~~ and stored under cover near the compost pits. Fresh earth is then added to replace the urine earth which has been removed.

(4) **Wood Ashes.**—These are useful for neutralising acidity and for increasing the potash content of the final product.

(5) **Water and Air.**—These are essential for the fungi and bacteria which manufacture humus.

Charging the Pits.

The pits are charged as follows :—A broad plank is first laid across the pits so that they can be filled without consolidating the material by trampling. A layer about 3 inches deep of mixed plant residues is first spread by a rake lightly and evenly over the floor of the pit. This is well sprinkled with a mixture of wood ashes (if available) and urine earth. A layer about 2 inches deep of broken up dung and soiled bedding follows. The contents are then well moistened (not flooded) with the hose. The charging and watering processes are continued till the pit is filled to a depth of 30 inches in all, finishing off with a layer of dung and soiled bedding followed by a good sprinkling of urine earth, ashes and water. The pit is watered in the evening and again the next morning. By giving the first watering in three stages, time is given to the mixture to absorb sufficient moisture to start the intense fermentation which soon sets in. Rapid shrinking then takes place and the contents of the pit contract to the ground level.

Watering.

The subsequent waterings are most important. The pits should be watered once a week and at the time of the first, second and third turns.

Turning.

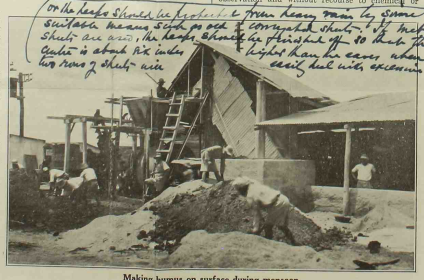
To ensure uniform mixture and decay and to provide the air and water needed by the organisms, the material is turned three times: *First turn.*—This is done when the pit is 10 to 14 days old. Half the pit is dug out with the fork, the contents are moistened and doubled lengthwise over the undisturbed half (Fig 3) : The half-turned heap is then well watered. *Second turn.*—Fourteen days after the first-turn, the material is again turned, watered and piled up loosely along the empty half of the pit (Fig. 4). *Third turn.*—When the pits are two months old, the dark crumbling material is moistened and stacked on the ~~adjacent~~ rectangular heap 5.5 ft. broad at the base, 9 ft. wide at the top and 3.5 ft. high—to ripen for a month, when it is ready for the fields. During the ripening period, a good deal of extra nitrogen is obtained by fixation from the atmosphere. When the humus is carefully made, the total gain of nitrogen may be as much as 25 per cent.

Humus Manufacture during the ~~Monsoon~~ Rainy Season.

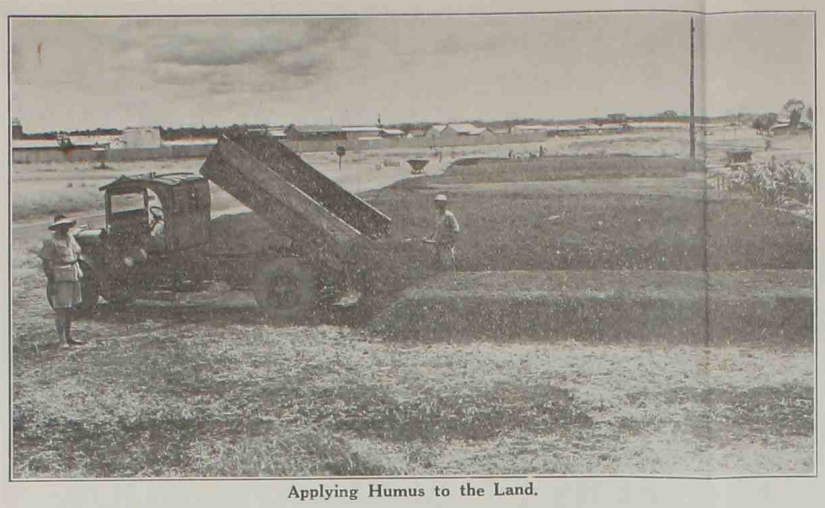
During the ~~monsoon, when the pits are often full of water~~, humus must be made in heaps on the surface. Where the rainfall is moderate, the heaps should be 8 ft. by 8 ft. at the bottom and 7 ft. by 2 ft. at the top, and 2 ft. in height. Where the ~~rainfall~~ is very heavy, composting should ~~always~~ be carried out under cover ~~as in this is impossible the heaps may have to be suspended during the period of very high rainfall—June to September~~.

Testing the Efficiency of the Process.

The efficiency of the process can be tested by observation and without recourse to chemical or



Making humus on surface during monsoon.



Applying Humus to the Land.

biological analysis. During the first month fungi are engaged in breaking down the mixed wastes. The heaps should be a mass of white fungoid growth and the temperature should be high. If a metal rod is inserted at this stage, it should be hot to the touch when withdrawn. After the third week the mass darkens in colour and becomes crumbly. Bacteria from now onwards take an increasing share in the process.

If at any time the fermentation stops and the pits cool, want of moisture is the most likely cause. Should the heaps begin to smell, flies will be at once attracted and will proceed to lay eggs followed by the development of maggots in large numbers. This only happens when there is some interference with the air supply. The remedy is to turn the heap at once and to add dung and ashes. The chief causes of insufficient aeration are excessive trampling, the addition of too much urine earth and ashes, over-watering or failure to turn the mass at the proper times.

Applying Humus to the Land.

Humus can be applied to land at the rate of 5 to 10 tons per acre and mixed with the surface soil at any time of the year except during ~~the monsoon~~ when it is almost certain to be washed away and lost. The best results are obtained during the ~~hot weather~~ and at the close of the rainy ~~season. When applied to the land after the rains, care should be taken to conserve the soil moisture.~~

The Finished Humus.

Humus consists of a dark, finely divided rich earth containing about 1 per cent. of nitrogen, about 0.5 per cent. of phosphoric acid and about 3.0 per cent. of potash. The composition naturally varies to some extent with the locality and the materials used. On the tea estates in Travancore, where compost is being made on the large scale under Dr. C. R. Harler's supervision at an average cost of about ~~Rs. 1-8-0 per~~ ton, the nitrogen content is as high as 1.3 per cent., the phosphoric acid and potash figures being very like those obtained at Indore. The value of humus, however, does not depend on chemical composition alone. This is only a part of the story. Humus improves the texture and water-holding capacity of the soil and also furnishes food materials for the soil organisms. The improvement of the physical texture of the soil and the stimulation of the soil organisms are, perhaps, more important than the nitrogen, phosphoric acid and potash supplied to the land.

Conversion of Municipal Wastes.

The Indore process has been successfully applied to the conversion of municipal wastes (town refuse and night soil) by Messrs. Jackson and Wad. Their results are to be found in a paper published in the *Indian Medical Gazette* of February, 1934, which has been reprinted as one of the bulletins of the Institute of Plant Industry, Indore, Central India. Copies can be obtained on application to the Director of the Institute. Adopted originally at three centres at Indore in 1933—the Residency Area, Indore City and the Malwa Bhil Corps—the method has since spread to other Central India and Rajputana States, and to a number of centres in British India, including Military Cantonments and Municipalities. The feature of the system is the great saving which takes place in the cost of disposal of these municipal wastes. The sale proceeds of the resulting humus, for which there is a keen demand, considerably exceeds the cost of conversion.

Perhaps the most interesting development which has occurred in the utilization of urban wastes is that at Nairobi, in Kenya, where the Express Transport Company has set up a commercial plant for converting the miscellaneous wastes of the town into a very valuable manure. The raw materials used are: coffee parchment, *boma* manure, tannery waste, slaughter-house refuse, horn and hoof, bones, cotton seed residues, chaff, wood ashes and crude limestone. These are finely ground when necessary, mixed in a rotary mixer (Fig. 5), moistened and fermented for 90 days (Fig. 6), according to the technique laid down in the *Waste Products of Agriculture*.

A very useful organic fertiliser is obtained, containing the following percentages: Organic matter 62.15, nitrogen 1.5, phosphoric acid 1.5, potash 1.5, lime 4.0.

The capacity of the factory is 20 tons a day; in 1934 the sales amounted to 3,500 tons; the price per ton at the fermenting pits is 14 shillings.

The Managing Director in a letter dated Nairobi, 26th September, 1935, reported:—

"The results obtained on controlled experimental plots, flowers, vegetables, maize, grasslands and coffee have, frankly, been amazing."

As one of the great needs of most of the plantation industries is a reserve supply of fermented organic matter of good quality at a reasonable price, this Kenya enterprise could with advantage be copied at many urban centres in the ~~East~~ West Indies.

Advantages of the Indore Process.

The advantages which are certain to follow the adoption of the Indore process ~~by the plantation industries of the East~~ in the West Indies are these:—

1. **Costs will be Reduced.**—The substitution of artificial manures, imported from abroad, by humus made on the spot from the waste products of the estate and by the ordinary labour force has already lowered the cost of production of coffee in Kenya and Tanganyika. A similar result is beginning to be obtained on some of the tea estates in India and Ceylon. The exact saving can easily be calculated when the following facts are known: the cost of making and applying humus; its chemical composition; the cost of importing and applying equivalent amounts of nitrogen, phosphates and potash in the form of artificial manures.

2. **Improvement in the Moisture-retaining Capacity of the Soil.**—Humus helps the soil to withstand draught.

3. **Increase in Yield and Quality.**—Not only will humus improve the yield per acre but it is likely to lead to better quality. This has already taken place in coffee. There is every reason to believe that similar results will be obtained in ~~tea~~ other crops.

A further view of process.

A further view of process.

INDIAN COTTON TEXTILE INDUSTRY.

(Continued from page 29.)

relied upon to provide the right type of man to supervise the running of Jute Mills, provided the necessary Engineering and Technical Training is available in the country.

In closing, one must comment on the attention the Government of India and Local Governments are giving to the Handloom Industry. Another good sign that bodes well for the industrial future of India is the tendency that is now being shown for power-driven mills to co-operate with the Handloom Industry for the mutual benefit of both. There is undoubtedly scope for both sections of weaving in India and it only needs goodwill and co-operation on both sides for the steady progress of the last few years to be maintained and be put on a more solid basis.

ROAD TRANSPORT PROBLEMS IN INDIA.

(Continued from page 30.)

the many taxes imposed by Municipal and Local bodies, the proceeds from which in some cases go towards a Road Fund. There remains nevertheless the need for not only similar methods of taxation but a fixed scale of taxation in all provinces which would permit a motor vehicle, having paid its annual tax in one province to operate throughout the country. If the Government of India in consultation with the Provinces could arrive at some basis acceptable to all, one of the greatest obstacles against the free circulation of motor transport would be removed.

An effort was made by Government of India at the Road Conference held in Simla in 1931 to bring about the introduction by Provinces of common rules and regulations regarding motor transport and although Model rules were drafted by the Provincial representatives present, little advance seems to have been made to bring them into existence. The matter is, however, understood to be receiving the attention of the Government of India and a member of the Legislative Assembly who recently raised a question regarding the need for compulsory third party insurance, and the validity of driving licences and fees, which should be applicable throughout the country, was informed that the matter is receiving the attention of the Transport Advisory Council. Some definite results might therefore be expected in these matters at a not very distant date.

With the removal of these obstacles and the placing of the taxation of motor transport and financing of road development on a sound and equitable basis we may look forward to the country enjoying the full economic, social and educational benefits which modern road transport offers.