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# THE PRINCIPLES OF MANURING PADDY.

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Paddy is one of the principal food crops of South India and occupies the largest proportion of the cultivated area. This crop has been, therefore, the first to receive the attention of the Department since the institution of Agricultural Research in this Presidency.

On the chemical side the study of the soil, and the crop, the inter-relationships that exist between soil conditions and crop growth, the mode of action of different manures and the influence of manuring on the quality of the crop have been under investigation. In discussing briefly the results of these investigations I have endeavoured to bring the findings of laboratory researches in a line with those of field experiments and to direct attention to the practical value of the results obtained and the problems of the future from the point of view of the ryot.

In any system of cultivation, the necessity for returning to the soil at least what has been taken out of it must be realised.

An acre of normal paddy crop takes from the soil 48 pounds of nitrogen, 23 pounds of phosphoric acid and 41 pounds of potash. If we visualise the soil as a bank it is obvious that, unless what is withdrawn is returned, the account will soon be over-drawn. But wise Nature has foreseen man's greed and in her infinite wisdom has provided against his sins of omission and commission by setting up in the soil a mechanism for the indefinite supply of the bare minimum requirements ordinarily termed 'minimum' cropping capacity'. So that, if the few pounds of the manurial constituents taken off are not returned there will not be an absolute cessation of crop growth but there will result crops poor in quality and quantity, an insufficiency of food and a devitalised population which falls an easy prey to all sorts of diseases.

That such a state of affairs exists to a certain extent is revealed by our soil surveys of the paddy tracts, carried out with a view to ascertain the extent to which the soils are in immediate need of manurial treatment.

| Name of the tract. | Percentage of soils deficient in | |
|---|---|---|
| | Nitrogen. | Phosphate. |
| Godavari. | 40 | 23 |
| Kistna. | 33 | 55 |
| Guntur. | 80 | 33 |
| Tanjore. | 87 | 80 |
| Periyar. | nil. | 90 |
| Malabar. | nil. | 90 |

This being the position in the chief paddy tracts it is obvious that intensive methods of cultivation and the introduction of heavier yielding strains will impoverish the fields still more if they are not properly manured.

Our recent research work has shown that a poor soil or inadequate manuring produces grain of poorer "seed quality" and lower nutritive value than a rich or well manured soil.

Recent work in England has shown that mineral deficiency in cattle foods brings about certain diseases among cattle.

It is therefore clear that, for securing increased yields, for keeping up the quality of improved strains and obtaining a crop with the maximum nutritive value, we must return to the soil all that is taken out and something more by adequate and judicious manuring.

From a study of the chemistry of the nutrition of the paddy plant it would appear that the most vigorous and consequential absorption of nitrogen is in the seedling stage, that of potash till about the flowering stage and that of phosphoric acid almost throughout the life of the plant. By about the flowering time the absorption of the food material is considerably reduced and the

energies of the plant are directed more towards the elaboration and translocation of the absorbed material.

The practical value of these observations is that dressings of nitrogenous manures after transplanting the crop are of little value but that similar dressings of phosphates are of benefit.

Our experiments have shown that of the three more important manurial constituents, namely, Nitrogen, Phosphoric acid and Potash, the last named does not appear to be necessary except perhaps where it is indicated to counteract disease. Nitrogenous and phosphatic manures are in general need and are responded to when applied either singly or together but their effect when combined is greater. Phosphatic manures have been found to stimulate the assimilation of nitrogen which would otherwise be not utilised and also to enrich the composition of the crop in this constituent thus enhancing the nutritive and seed value of the grain.

The results of a large number of pot cultures and field experiments on our experiment stations at Coimbatore, Samalkot, Sirvel, Nandyal, Manganallur and Palur show that all the artificial nitrogenous and phosphatic fertilisers are more or less beneficial to paddy but that they are generally economical when applied in conjunction with bulky organic manures like cattle manure and green manures. Of the latter class of manures, green manures, stand out prominently as most suitable for paddy. This is a fortunate circumstance as cattle manure will then be available for the other systems of cultivation.

The relative merits of the different systems of manuring may be expressed in numerical values taking green manure as the unit of standard.

| | | |
|---|---|---|
| Artificials | No manure | 0.33 |
| | Phosphate alone | 0.50 |
| | Nitrogen alone | 0.70 |
| | Nitrogen plus phosphate | 0.90 |
| | Green manure | 1.00 |
| Artificials with organic manures. | Green manure *plus* phosphate | 1.20 |
| | Green manure *plus* nitrogen | 1.33 |
| | Green manure *plus* phosphate *plus* nitrogen | 1.60 |

It is seen that artificial manures are not as efficient as green manure and that the efficiency of either class of manure can be considerably improved by combining them. Our researches indicate that organic manures supply in plant nutrition some substance analogous to *vitamins* in animal nutrition and that for our soils organic manures are therefore essential. The importance of organic manures to crop growth and the limited nature of their supply at once raises the question as to the most satisfactory proportions in which artificials and organics should be used. This aspect of the problem is under investigation but in so far as the Coimbatore soils are concerned it would appear that twenty pounds of artificial nitrogen and thirty pounds of organic nitrogen make a suitable combination for paddy. It is to be remembered that the fullest benefit of puddling in green manure cannot be realised unless the toxic products resulting from its decomposition are drained off or sufficient interval is allowed between the puddling and transplanting. It is true that this is not always in the control of the ryot and his scheme of operations is regulated largely by the availability of water.

The value of green manure lies more in the physical benefits it confers in inducing optimum drainage which is very important for the proper growth of paddy. Where the heavy nature of the soil is an impediment to quick drainage and consequent removal of the toxic products, application of lime may meet the situation.

In regard to the question whether it is advisable to apply green leaf from outside or to grow green manure *in situ* the former course is undoubtedly better as it adds extra manurial constituents in the shape of phosphoric acid and potash even if the nitrogen may not be available. Where, however, green leaf cannot be had, green manures may be grown *in situ* and puddled in. The opinion held in some quarters that this practice tends to reduce yields does not appear to be correct as our experimental evidence points to the contrary. Any observed fall in yields may be due to deficiencies in other directions.

I have so far dealt with manuring in relation to plant nutrition: There is the question of human and animal nutrition raised by Mr. Iliffe and I will briefly state the findings of our experiments.

The soils of the Godavari and Kistna deltas are relatively richer than those of the Tanjore delta and we find that rice grown in the former delta soils, is more nutritious than rice from Tanjore. It has also been ascertained that the vitamin value increases with the phosphate content of the grain which is influenced not only by the soil on which it is grown but also by the method of preparing rice. Parboiled rice has lesser nutritive value but it is superior to raw polished rice which loses a considerable amount of minerals and fat, containing vitamins, while being polished.

In regard to suggestions for future work, the desirability of growing green manure in the place of a short duration variety of paddy in double crop lands may be looked into but here again the ready money that will come to the ryot from the sale of the short duration crop, will be an obstacle even if its sacrifice is not found to be a financial loss in the long run.

The evil effects of ploughing lands in which sugarcane crop is introducec in a 3 - or a 5 - year rotation as noticed in some parts of the Godavari delta will have to be investigated.

Another problem for investigation is to see whether the manure bill cannot be reduced by transplanting seedlings raised from a properly manured seed bed and cutting down the quantity of artificial manures for the bulk area.