

of the district, tobacco and chillies, and there was a belief that groundnut has been responsible for the attack of 'thrips' on chillies, which crop has consequently suffered. Ryots also believed that groundnut spoiled the texture of the soil.

Dr. Patel replying said that he agreed with Mr. Jogi Raju that higher seedrate gave a higher yield and quoted the experience of America and Mysore on the point. He then observed that lime was not necessary in normal average soils. Answering Mr. Paramanadam he said this was the first time he heard of groundnut spoiling the texture of the soil.

Mr. K. Raghavachari observed that seed rate depended upon a number of factors. In the Ceded Districts, the ryot sows his crop with a drill and then intercultivates it, so that he has to use a low seedrate, because a high seedrate will leave very little space for intercultivation; another point was that the greater the rainfall, the greater was the seedrate. In Kollegal and Palur, where rainfall is heavy even a seedrate of 100 lb is used. Answering Mr. Rajagopalachari, he said, that ryots moisten the seed, so that the kernels do not split. This practice introduces moisture which is favourable for fungus and mould attacking the kernels.

SOME RECENT MANURIAL EXPERIMENTS IN RICE*

BY K. RAMIAH, L. Ag., M. Sc., Dip. Agri. (Cantab).

Paddy Specialist.

Introduction. The principle of manurial trial or in fact the principle underlying any form of agronomic experiment is to get a bigger yield per unit area. We only measure the end result of the treatment and we had no clear idea until recently as to how this increased yield is brought about. Developmental studies on the rice plant undertaken in Coimbatore have shown that the two important attributes to yield are (1) the number of tillers or ears per plant and (2) the number of grains per ear. A proper understanding of the influence of environment which includes the different forms of manurial trials, on these two developmental phases of the plant is extremely important. A number of experiments have been conducted recently in the rice stations and while the fuller details of these experiments are published in the station reports an outline of the salient features are given in this note.

Spacing and Manuring. Several experiments have been conducted in the research stations in the past with different spacings and with different manures. The two treatments were, however, not combined, to find out their interaction. This has now been done for three seasons in Coimbatore, Pattambi, Maruteru and Berhampore representing four different types of soils and cultivation practices. The seedlings were planted with different spacings with and without manurial application to the transplant field. I shall state here only the final conclusions reached. The optimum spacing varies with the different tracts. While it is about 4½ to 6 inches in Berhampore and

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Pattambi, it is about 6 inches, in Coimbatore and is definitely more towards 8 to 9 inches at Maruteru. While the above are for long duration varieties, 5 months and more, the optimum spacing for short duration varieties is never more than 4 inches. Spacing has a greater influence on tillering or the number of ears per plant, than manuring. But the increased number of ears per plant brought about by wider spacing compensates for the reduction in the number of plants only up to a limit. The action of manure appears to be chiefly confined to its influence on the second yield attribute, namely, the size of the ear. While spacing has its principal effect on the vegetative phase, manuring has its effect chiefly on the reproductive phase. Even for increasing the number of tillers per plant there must be a certain limit of optimum fertility. It follows therefore that manuring is necessary more when the ears are forming. To get the maximum benefit the manuring must come in two stages, firstly to improve initial fertility where it is known to be low and secondly to influence the size of the ear at a later stage. Too much of initial fertility, either natural or added, hastens vegetative development unduly and there is not a proportionate increase in the second yield attribute, namely, number of grains in the ear. This takes us to the next consideration of when the manure is to be applied to have its full effect on ear-formation.

Time of Application of Manure. Naturally the manure has to be a quick acting one, a chemical fertiliser, and so far as the available results go, ammonium sulphate appears to be the only manure that can be used profitably. When this has to be applied varies with the different tracts and the varieties grown. In short duration varieties it has to be applied soon after planting as there is not sufficient interval between the two phases of development. For longer duration varieties, five months and above, the optimum time is found to be a month after planting at Maruteru, six weeks at Coimbatore and 2 months at Pattambi and Aduturai.

Applying Manure to the Seedbeds vs. Transplant Fields. Another question concerned with the manuring, is where the manure should be applied, whether in the seed-beds, or in transplant fields or in both. Experiments have been conducted at Coimbatore, Maruteru, Aduturai and Berhampore with regard to raising seedlings under three different conditions namely, unmanured, normally manured and intensively manured, and the three types of seedlings were planted in manured and unmanured fields. In Coimbatore the experiment was conducted with three varieties of different durations, 4, 5, and 6 months. The fairly uniform results obtained over two seasons at all the stations under different conditions add particular significance to their importance. In all the stations it was noticed that though the intensively manured seedlings were very much in advance of the rest at the time of planting, the differences levelled out gradually and the manuring

or non-manuring of the transplant field was the chief condition that influenced the final yield. Irrespective of whether the seed-bed is manured or not unless the transplant field is manured no beneficial results are obtained.

Manuring of the transplant field increased both the yield attributes in the early varieties, but only the ear size in the late varieties.

In addition to manuring, the rate of sowing in the seed-bed was also tried in Coimbatore and Maruteru and the results point out that thinner sowing has a greater influence on the plants' subsequent development than manuring.

It has been ascertained by actual experiments in Coimbatore that the roots, and probably the leaves also do not function for some time after planting, i. e., until new roots are formed. Moreover, the rapidity of establishment of the seedlings after planting is an important consideration. The quicker establishment and quicker starting of the vegetative development which certainly affect final yield are more influenced by the fertility of the transplant field.

This does not mean, however, that seed-beds need not be manured at all. Unless the seed-bed area is too poor, which is usually not the case, all the available manure may be profitably applied to the transplant field. Intensive manuring of seed-beds has some significance only when we want to force the growth of seedlings to get them ready for planting early, especially when the season is late.

General Principles of Manuring. With regard to general principles of manuring rice, several experiments have been going on for a number of years in the different agricultural stations. S. N. Venkatraman* (1932) has summarised all the results obtained up to 1931 and comes to the following conclusions in his report. "Green manuring is found to be beneficial to the rice crop universally throughout the Province. Nitrogenous fertilisers like ammonium sulphate either by themselves or in conjunction with leaves have a limited application except in soils specially deficient in nitrogen as in Manganallur and to a less extent in Coimbatore also. Phosphates, bonemeal and super (preferably the latter), generally have some effect in soils deficient in phosphoric acid. They have always to be applied in conjunction with leaves, they having no value by themselves except in one case, viz., Manganallur. On Anakapalle and Palur soils the phosphates are of no use".

The evidence from the report was also fairly definite that except green manuring the use of fertilisers in any form was not economical. It has also been stated in the report that in fertile soils capable of yielding about 3,000 lb. of grain per acre, the effect of any manurial treatment was negligible.

* Officer appointed on special duty to collate the results of manurial experiments in all the Agricultural Research Stations, Madras—Unpublished data.

It may be worth while to consider the several manurial experiments that have been carried out in Coimbatore, Maruteru, Aduturai, Pattambi and Berhampore since the compilation of the above report.

(a) *Maruteru*. Maruteru represents one of the most fertile tracts under rice in this Province. There are two crops of rice grown but so far as the first one is concerned the yields are mainly dependent upon the season, particularly the absence of rains in summer. Rainless summer and early planting give high outturns and any attempt at manuring does more harm than good, causing premature lodging of the crop. The beneficial effect of green manuring is to be found only in a bad season when it counteracts the bad effects. In any case the increase of crop obtained by green manuring or by any artificials has never been more than about 10 per cent. But the effect of green manuring was particularly noticeable with the second crop where increase of even 20 to 30 per cent. in grain yield has been recorded.

(b) *Berhampore*. The soils represented by Berhampore in Ganjam are very much poorer in fertility compared to Maruteru. Experiments have been conducted with different quantities of green leaves from 2,000 to 6,000 lb. per acre. There was a progressive increase in yield, a 15% increase with 2,000 lb. going up to about 30% with 6,000 lb. A small dose of ammophos in conjunction with green leaves gave a definite increase in yield but the increase was not found sufficient to cover the extra cost of the fertiliser.

The conditions at Pattambi are very similar to those of Berhampore and the results obtained are also similar.

(c) *Coimbatore*. In Coimbatore where the standard of rice cultivation is probably higher, a dose of 4,000 lb. leaf gives about a 15% increase in yield. In one of the experiments in the Central Farm, green leaf has been tried from 2,000 up to 12,000 lb. per acre. There is found some increase, not regular though, up to 8,000 lb. and the increase is not apparent with still increasing doses.

(d) *Aduturai*. In Aduturai also the beneficial effect of green leaf is apparent and everyone is familiar with the difficulty of growing a green manure crop in Tanjore. The only possibility of growing a green manure crop lies in sowing it in the standing rice crop just before its harvest and this can be done only with either indigo or wild indigo. If there are any rains in summer they bush out properly and give enough leaf, but if the summer should prove dry, not much of leaf is obtained. The attempts made at this station to grow some green manure crop as soon as water is received in the channels for the single crop lands and ploughing it in before planting, are promising. There is enough scope to do this provided water is received in the channels early enough.

If the land could be ploughed in summer and a green manure crop raised as is done in Coimbatore, the cost of raising a green manure

crop goes high but the produce from one acre may be sufficient to apply to three to four acres.

Though it is true that green manuring is more effective in poor lands, the ultimate quantity of increase is not great as the initial yield is itself low in these lands. A 20% increase in Berhampore will be the same as a 12% increase in Maruteru. Probably there is not a big difference in the value of the increased produce obtained due to manuring. At the present price of rice, the value of the increased produce obtained in the different stations varies from Rs. 6 to Rs. 10 per acre though the figures are higher for Coimbatore. If manuring is to prove an economical proposition, the cost of the manure applied would have to be very much less than Rs. 10 per acre and under these conditions, green manuring is probably the only treatment that might be considered except in very special cases where fertilisers in addition to green manuring might be thought of.

There is one interesting observation recorded in the results of these experiments, namely, that the improved strains always give a better response to manuring and better cultivation than the unselected bulks. The mere value of the strain consists in its ability to make better use of the natural fertility and if this could be improved, the response is also greater. It is possible that the ryots are not realising the full benefits of the improved strains because their fields are not in the optimum condition of fertility.

Need for more work in special Tracts. Just as in breeding even with regard to manuring the conditions vary from place to place and the results of one place are not easily applicable to another. This obviously necessitates intensive experiments in as many centres as possible before any recommendations could be made. It is sometimes stated that all the problems of rice growing have been solved and that the lines of work in rice are very simple. As one who has worked intensively with the crop for nearly 20 years, I feel that the more you intensify your work, the more you find certain definite gaps in our knowledge about this crop plant. It is sometimes mentioned that because of the fall in price of the produce, there is no necessity to carry on much intensive work with this crop, but I feel that the low price and consequently the low return realised by the rice grower must be a reason for more intensive studies from all aspects.

Discussion.

Rao Bahadur K. S. Venkatarama Ayyar, observed that ryots knew about the value of green manure for paddy, but he did not see how it was possible to apply the green manure, after the paddy crop had grown up, as was suggested by the author, to give good results.

Mr. K. Ramiah said that it was not green manure that he meant should be applied after the paddy crop was on, but fertilisers like Ammonium Sulphate, which were best applied at different stages of the crop.

Rao Bahadur K. S. Venkatarama Ayyar, humbly remarked that cattle trespass was a serious problem in his district, and the man who foresightedly raised a crop of green manure during the summer for his paddy lands, very often found to his cost that he provided good pasturage for the village animals. Even crops like daincha and indigo which were known to be non-edible to cattle were now being eaten up by them in Tanjore. He appreciated some of the new points contained in Mr. K. Ramiah's paper, particularly the one about the manuring of rice seed-beds, and he hoped to benefit by it. There was also another difficulty with regard to applying fertilisers to rice fields in that there was the risk of the manure being washed out of the fields as the irrigation water could not be controlled properly as is usual in Tanjore.

Rao Sahib T. V. Rajagopalachari pointed out that in some parts of Madras people preferred carting leaves to rice fields from outside even at enormous costs to growing a green manure crop in the land itself. He also pointed out that there was an impression often expressed that the produce obtained from a green manured field was insipid in taste when compared to the produce grown without any manure.

Mr. K. Ramiah replied that in several experiments, there has not been any perceptible difference between green leaf manuring and green manuring. As regards the quality of the produce he thought that the cooking qualities were probably more dependent on the harvest and threshing practices rather than on manuring and he mentioned the case of Tanjore produce of a particular variety (Nellore Samba) fetching less price than the same from elsewhere. He also pointed out that the difficulties of cattle trespass with regard to growing a green manure crop were remediable and he pointed out that under very similar conditions in the Godavari delta, the practice of growing sunhemp as a green manure crop was extensively in vogue and that Godavari ryots were able to maintain better type of cattle than in Tanjore.

THE PROBLEM OF MILK SUPPLY TO CITIES

BY T. MURARI Esq., B. Sc., (Oxon), F. L. S., F. R. S. A.

Intensive urbanisation of a population always creates certain problems which need solution. Housing, lighting, transport, roads and medical aid and food supply are the more important problems of the urban population. As it is not within the scope of this article to study all the problems, only one aspect of food supply will be considered. Milk supply to an urban population has become increasingly important of late, as people find it difficult to maintain a cow to supply home requirements. In cities like Madras where the milk supply is dependent on professional milkmen the problem is acute. Depending on their prosperity these milkmen keep a limited number of cows and try to meet the demand as best they can, with the result that the housing of cows and sanitation in general do not come up to a high standard.

In the absence of a sufficiently strong public opinion these drawbacks have not been rectified. Moreover, the house-wife is not prepared to pay a higher price for a better quality of milk, and the milk man in his turn wants to make profits. These are limited as the cows do not give sufficiently high yields so as to show profits. The result