

## ORGANIC *VERSUS* INORGANIC MANURES.

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The ultimate aim of all agricultural experimentation is to make the lands more and more productive. In India the soils in general are low in productive capacity and it has been found that the soils are deficient in many of the plant food elements such as nitrogen, phosphorus, etc. All crops take up from the soil, nitrogen, phosphate, potash, calcium and other essential elements and unless these losses are made up by some means the fertility of the soil cannot be maintained for long. It is therefore vitally important to maintain and also raise the fertility of the soil by suitable manuring practices.

It has been found by experience that nutrients such as nitrogen, phosphorus, potassium, etc., which are usually present in the plant itself are necessary to the soil. In 1840 Liebig, the German Scientist showed that mineral matter was indispensable to the growth of plants and must be supplied in sufficient quantity in the form of simple salts. The food substances added to the soil are broadly divided into two groups, i.e. manures and fertilizers. In fact this grouping is not very strict. By term 'manure' it is generally meant 'Bulky manure' which is primarily organic in nature, while fertilizer which is mainly inorganic is considered to be a concentrated substance of a particular nutrient or a mixture of nutrients. When organic manure is added to soil it supplies nutrients such as nitrogen, phosphate, etc., and in addition organic matter which goes to build up humus required for the building up of soil structure and fertility. In addition to the major elements supplied by fertilizers there are other equally important nutrients such as manganese, boron, cobalt, etc., which are known as 'rare elements' or 'trace elements' as they are required by plants in small quantities. The importance of these elements was not realized in earlier days as the fertilizers then used were carrying these elements as impurities. However, when pure fertilizers were used the plants suffered from what are known as 'deficiency' diseases. Furthermore, it has now been observed that the presence of these trace elements such as manganese and iron in the soil in addition to organic matter helps to increase the biological activity in the soil.

The plant food produced by organic manures is as good as that supplied by inorganic manures. But there is an important difference in that the organic manure is given in large quantity when compared with inorganic manures and the organic manure gets decomposed very slowly and supply the plant with food in small doses while the inorganic manure supply the necessary requirements all at once in a soluble form. In earlier days it was considered that this slow decomposition helps the plant in getting the required nutrient at different intervals and at the same time helps to maintain the fertility of the soil. Furthermore, it was felt that the plants take up only a small quantity at a time and therefore slow liberation of nutrient is beneficial to the growth of plant. This, however, is not wholly correct.

Organic manures such as farm-yard manure, green manure, etc., when incorporated into the soil not only add the nutrients such as nitrogen, etc., but the soil is enriched by the fixation of the atmospheric nitrogen. Dhar (1943) has stated that the residual effect of a manure will depend on its power to fix atmospheric nitrogen. Such materials show residual or beneficial effect to succeeding crops. He (1949) has further stated that when ammonium salts or nitrates are added to the soil, a better yield is obtained but these materials do not add any humus. In such

a case hardly any nitrogen is saved for the next crop. At Rothamsted, application of green manure like clover show that the residual effect of this manure last for about 3-4 years and that of farm-yard manure is more permanent. Further the organic matter adds humus to the soil which improves the soil texture making heavy soils lighter and lighter soils heavier.

The experiments with farm-yard manure have shown that the physical properties of the soil are improved when compared to the soil treated with artificial fertilizers. Basu and Kibe (1949) have shown that with the application of farm-yard manure, the average carbon and nitrogen contents of the soil are raised considerably, although the effect is more pronounced in the surface layers of the profiles than in the lower ones. They have further stated that the fertility of the soil is greatly enhanced by the application of the manure as judged by the increase in the level of some important dynamic fertility factors. Basu and Tagare (1942) have also shown that application of organic manure such as farm-yard manure increases the yield of sugar-cane and improves the quality of *gub.* Basu and Sirur (1943) while working on the effect of different rotations on soil structure have shown that the single value constants in Sann and Patada shevra indicate on the whole a better micro-structure than others in which bajri and fallow come next best while cotton and ground-nut are the worst.

G. Ruschman while supporting the use of organic manures has expressed that 'The increase in soil fertility which is the aim of all modern scientific and practical efforts, cannot be attained by mineral manures. Increase of crop by improving soil properties and greater returns by addition of plant food in easily available form are two different things which are often confused. Mineral manures accelerate the breaking up of humus and as such prove detrimental. Directly or indirectly all plant and animal life is made possible by the soil humus. To its increase may be systematically employed all the organic material which is at present virtually wasted.' Viswanath and Suryanarayan (1927) and McCawson (1926) have shown that certain millets, wheat and rice grown with cattle manure have better nutritive values than crops grown with artificial or chemical manures.

As regards inorganic fertilizers, it has been observed that fertilizers such as ammonium nitrate, ammonium sulphate do not enrich the soil and increase the soil fertility permanently. Most of them are lost in the form of nitrogen gas without any addition of nitrogen to the soil. At Rothamsted, experiments on wheat with fertilizers have shown that the fate of the missing 65% of the nitrogen from the fertilizer was finally traced to leaching from the soil in the form of nitrate. This effect was complete within a year and no effective residue remained for the succeeding crop. Farm-yard manure supplying, however, much more nitrogen, gave very different results. A certain amount of nitrogen remained in the soil and some of this became available for the crops in later years. The application of farm-yard manure at Rothamsted for a number of years has increased the nitrogen status in the soil from 0.12% to 0.236% in the course of 70 years. Repeated additions of ammonium sulphate or sodium nitrate did not improve the nitrogen status at all. Beneficial effects of organic manures over nitrogenous fertilizers

*Yield of wheat lbs. per acre.*

N. per acre.	F.Y.M.	Compost.	Night Soil.	Amm. Sulphate.
37 lbs.	1422	1303	1348	1066
73 lbs.	1526	1526	1807	1111
110 lbs.	1532	1881	1837	1241

have also been noticed at Allahabad and other places in India. Panse and his co-workers have shown that at Indore, at the high level of nitrogen applied under irrigation, nitrogen from organic manure proved more effective than ammonium sulphate.

They have further shown that response to organic nitrogen was also generally positive in the unirrigated trials. At Jalgaon responses were preponderantly negative to applications of mixed fertilizers containing ammonium sulphate, sodium nitrate, calcium cyanamide, superphosphate, etc., and this result is traced to the moisture deficiency in the soil.

Rege and Basu (1932-44) while working on sugar-cane have indicated that whenever top dressing of nitrogen in the form of organic manure such as cake is given the absence of basal dose of compost does not produce any appreciable detrimental effect even for two rotation cycles. In the cases of different proportions of sulphate of ammonia and cake its (basal dose) application can be dispensed with at the most for one cycle. On the other hand, if all nitrogenous top dressing is applied in the form of sulphate of ammonium alone, it is but essential to combine it with a basal dressing of compost for each crop of over 20,000 lbs. which is used in this experiment.

Further Rege and Basu have shown that response to manures depends also upon the soil types. While studying the response to basal application of compost and its interaction with the top dressing it has been observed that the mean response to compost is highest in F type (27%) and in D type the lowest (5%). This difference can be attributed to the nature and amount of colloids in these soil types.

The other point to be borne in mind when comparing the efficacy of organic and inorganic manures is the availability of moisture in the soil. Experiments with the inorganic fertilizers conducted at the Dry Farming Research Station Sholapur and its substations indicate that in the years of low and erratic rainfall the crops get scorched and many a time even the germination is affected. This is not the case with organic manures such as farm-yard manure, green manure or cake manure. Experiments with organic manures on Jowar (Rabi) at Sholapur have shown that the yields of Jowar could be raised considerably by these manures. At Rothamsted, it has found that farm-yard manure is most effective in dry seasons. Rainfall, however, has less effect on the action of farm-yard manure than on that of artificials, and so it happens that the superiority of farm-yard manure over artificial is most marked in dry seasons. Farm-yard manure thus has a steadying effect on yield besides its action in maintaining the fertility of the soil and minimizing the deterioration in yield often associated with continuous cropping. At the Dry Farming Research Station, Sholapur, it has been noticed that the conservation of moisture can be effectively done by the application of organic manures. Furthermore, it has been found that the microbiological activity in the soil is enhanced by its incorporation. The application of bonemeal has indicated that the level of phosphate in the soil can be conveniently raised but the effect on yield is comparatively slow. While in the case of superphosphate the results with regard to yield of jowar could be immediately seen in good rainfall years but in the year of adverse rainfall the germination of the crop—cereal as well as legume—is affected considerably by the application of superphosphate. This is not the case with bonemeal. Viswanath (1931) has pointed out that the effect of farm-yard manure on the first 36 crops was generally inferior to that of complete mineral fertilizers while average yields for the 37th to 56th crops favour the farm-yard manure treatments. Green manure was usually not favoured in the dry tracts in view of the limitation of moisture but recent experiments with the application of green manure to Rabi jowar with a suitable technique in Bombay State have indicated that even in dry tracts green manure could be beneficially used to increase the yield of jowar considerably while the ratio of C : N. can be maintained within

reasonable limits. However it can be said that barring a few experiments on certain dry crops where inorganic fertilizers are tried there are no data to give the comparative effect of organic *vs.* inorganic manures in dry tracts. While it is very difficult to say at this stage whether organic manure is superior to inorganic manure or *vice versa* to increase crop yields in different soils it has been found by experience that if the fertility of the soil is to be raised permanently it could be only done by the application of organic manure. Long range experiments with farm-yard manure carried out at different places in India have shown that though in the first few years no significant higher yields for different crops were obtained the yields thereafter have been obtained at the sustained higher level. Furthermore, the feeds obtained from application of organic manures are superior to ones obtained by application of inorganic fertilizers. According to Stewart, whilst it is of the greatest importance not to underestimate the virtues of humus and the need of bulky organic manures in general maintenance of soil fertility, it is equally important neither to overstate the case for their use nor to minimize the value of mineral supplements. Too often there is a tendency to regard manurial problems as a controversial meeting ground but to do so is to ignore the facts.'

The general evidence has shown that organic and inorganic manures have their uses and both should be regarded as complementary to each other.

Inorganic manures could be used to produce humus in indirect way as for instance, in the phosphatic manuring of legumes or green manuring crops or in ley farming with artificials. Further, suitable crop rotations are also useful in maintaining the desirable organic matter status and soil structure especially where the organic manures are not available in large quantities.

In conclusion although it may be said definitely today that in any sound scientific agriculture a balance must be maintained between the two types of manuring, emphasis should be shifted to one or the other type depending on the many diverse factors such as soil type, climate, nature of crops, cultural and rotational practices and socio-economic conditions of the locality. The foundations of such a composite system of manuring should, however, be always based on our ever-increasing knowledge obtainable through experimentation and research conducted over a long period on different soil climatic complexes.

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