*Farmers in Gujarat experiment with Micronutrient Fortified Compost. The results are promising: higher yields, more efficient use of farmyard manure, better payment of farm labourers and an improved hygienic conditions in villages.*

# Micronutrient Fortified Compost

**Jagdish Nazareth**

It is now more than 10 years since I first visited Jakhda village in Dholka Taluka, a semi-arid region in Gujarat, India. I was moved by the physical conditions and health status of a small community of Harijans in that remote village. I tried to work out some way of helping them develop their main occupation. This was the removal of *ukarda*, Farm Yard Manure (FYM) from the houses of the villagers and dumping it in piles on the outskirts of the village. There it remains to decompose for about one year until the houseowner applies it to his fields. This was the beginning of the work done by the Institute for Studies and Transformations (IST) that led to the invention of "Micronutrient Fortified Compost" (MFC) in 1987.

## Not enough ukarda

The ukarda system is based on transfer of biomass from grazing land to the small fraction (30-50%) of the village land which is actively cultivated. This transfer of biomass is an important factor in degradation of the "common" land. To get acceptable results, farmers typically apply high rates of ukarda, from 12-15 tonnes/ha for field crops like wheat and rice to 30-40 tonnes/ha for flowers, vegetables and cash crops. For this rate of application there is not enough ukarda, which means that it can only be applied once in 2 to 3 years.

Most of the work involved with ukarda is done by the lower castes and the women. The work often pays less than other farm work. Due to low economic benefits to labourers as well as farmers, not enough care is taken to prevent nutrient losses. So the environment degrades, people are exploited, rural labour is underutilised, settlement hygiene is poor and an important agricultural input is underutilised.

## Deficiencies in micronutrients

Plants can take up chemicals directly if they are supplied to them. But in natural conditions the microbiological world around a plant is a huge economic trading system by which chemical nutrients are pulled out of organic matter and minerals and delivered to plant roots. The microbiological trading system also concentrates nutrients that are needed by plants. Plants repay this favour by creating the environmental conditions which favour the very existence of this microbiological world. For example, in a soil with low phosphate levels, mycorrhizae concentrate phosphates and pass them on to plants in exchange for carbohydrates.

However, there are limits to microbiological activity due to, among others, deficiencies in micronutrients. This can cause metabolic disorders, diseases and stagnation in growth in the chain of plant-animal-human populations which depend on each other for nutrition.

## Hypothesis of Indirect Nutrition

The Hypothesis of Indirect Nutrition recognises that plants take up most of their nutrients in a form conditioned by microorganisms and therefore external nutrients must be added essentially to provide nutrition to microorganisms, which will feed the plants. For example, if we want to boost the nitrogen fixing capacity of the soil, so that soil microorganisms can fix enough nitrogen for the plants, then we should ensure that the soil has all those nutrient elements available for nitrogen fixing organisms to thrive. Once the focus shifts from plant nutrition to microbial nutrition, we are dealing with a completely different vector of inputs. This microbiological enhancement theory has the advantage of being "homeopathic" in its use of external chemical nutrients. We are saying: do not

*This farmer has applied 3 tonnes of MFC on 4000 $m^2$ irrigated land. He obtained 400 kg more castor seeds (Ricin communis) than with a field that received 3 tonnes of Farm Yard Manure in an equivalent area.*

*The fennel on the left of the photo was not fertilised with MFC but received water. The fennel on the right was fertilised with MFC but starved of water. Yet the MFC fennel has fruited while the non-MFC fennel is only in bloom.*

add urea, it is not necessary. Do not add water soluble phosphates, they are too costly and not needed. Do not add 4 tonnes/ha chemical gypsum, but 100 kg. Do not add 50 kg/ha iron sulphate, but 2 kg. Do not add 25 kg/ha zinc sulphate, but 1 kg. Do not add 200 g of ammonium molybdate per ha, but 20 g.

Microorganisms need acceptable levels of 18 elements. These are all provided in basal doses to ensure adequate nutrition with booster supplements of those elements which are deficient in the soil and water of the fields where they are applied. So, compared to conventional methods of soil fertilisation, instead of adding large quantities of a few nutrient elements, we add small quantities of all essential elements, taking cognisance of the actual, prevailing soil and water concentrations of the 18 elements.

### Micronutrient Fortified Compost

Several years ago a Maharashtrian farmer, N.A.D. Pandhuripande, developed a simple pit for composting agro-waste. This compost pit is built in brick above the ground. It is 10 ft long, 8 ft wide and 4 ft high. At regular intervals, 66 airholes are created in the masonry by leaving out a brick. Compost is prepared in this NADP Compost Pit by building layers of soil and agro-waste and topping them with cowdung slurry. This repeated ten times fills the pit about one foot above its top. Then the whole is plastered with cowdung. NADP Compost is ready in about 90 days without turning it around as this is too laborious. This can be compared with village ukarda which takes a year. However, NADP Compost provides too little economic return in Dholka. IST therefore started potentiating NADP Compost to raise it to the status of a biofertiliser by fortifying the compost with micronutrients. We called it Micronutrient Fortified Compost (MFC).

*The rose in the right hand of Shri Balwant Lakum is from a field fertilised with MFC, the one in the left hand is from a control field. Over a period of 15 months there was a 200% increase in bloom production over control.*

### Experimentation by farmers

Initially we experimented in our nursery. After that the work was extended to 64 families in 35 villages in Dholka Taluka. Experiments were conducted by farmers on their own fields with 15 different crops, rice, wheat, millet, sorghum, gram, fennel, cumin, lucerne, castor, guavas, lemons, roses, pomegranates and a range of vegetables. Participants' controls were usually their existing local practice. Most have honoured our guidelines for experimenting but quite often there were deficiencies which turned their trials into interesting observations only. Though our quantification procedures may appear scientifically inadequate, all participants are convinced that they have experienced very beneficial results from MFC usage.

### Economic returns

Under 1993 price conditions in Gujarat the farmer's cost of producing MFC is approximately Rs 200-250 per tonne. In this, the cost of added nutrients is approximately Rs 50-60 per tonne. The rest of the cost is local raw materials and labour. For comparison, Diammonium Phosphate costs Rs 4,500 per tonne, Urea Rs 2,500 per tonne. MFC is based on 98% renewable manures, organic residues and soil. It can be used in two ways. Firstly, it can be used in the traditional manner of compost, by application to fields at rates of 0.3-1.2 kg/m2. When used in this way, farmers experienced increases in crop yield by 15-200% when compared to existing local practices. Secondly, it can be used as a biofertiliser or a seed treatment or a germination media additive for seedlings. In this mode, between 30-100% MFC on the weight of seed can be used for treatment. Yield increases were experienced that vary from 10-60% from seeds treated this way. When used in the compost mode, benefit cost ratios of applying MFC ranged between 3:1 to 10:1 for field and annual crops within a period of 12 months. In orchard crops however, the benefit cost ratio ranged from 30:1 to 80:1 within 12-15 months. But when MFC is used in the biofertiliser mode, the benefit cost ratio ranged even from 80:1 to 150:1 within 12 months.

MFC reduces the recommended application rates of all fertilisers substantially. When ukarda is used as MFC the application rate typically comes down from 12-40 tonnes/ha to 3-10 tonnes/ha (= 7.5-25 tonnes/ha MFC) when used as a soil fertiliser and to 100-150 kgs/ha when used as a seed treatment. Crop yields on the other hand are generally better just as the quality of the crops in such parameters as size, weight, taste, fragrance, fibre length and strength. Crop resistance to drought, bacterial and fungal diseases also improved. We have a curiously fortunate situation where less gives more. Due to the better use of ukarda when used as MFC and quickening of the turn-around cycle of traditional composting from 12 to 4 months, also the hygienic conditions of the village settlement will improve.

### Further development needed

The use of MFC requires a person skilled in plant and bacterial biochemistry to correctly interpret visual signs of nutrient deficiencies in plants. Or it needs a testing programme where the soil availability levels of all 18 essential elements are known at the same time. Or both. The technology is available but what remains to be done is to integrate testing capabilities and statistical procedures with geographic information and remote-sensing imageries to provide a cost-effective system of advising farmers. We are trying to devise a Farmer Information System for a block of 70 villages in an area of 1000 km2 in the Sabarmati River basin in Gujarat. When this FIS is in place it will also become a new research tool for examining linkages between plant, human and animal nutrition.

MFC is still in the experimental stage. More experiences are needed in different agroecological conditions. A start was made by two NGOs. Both have reported favourable results in rice and wheat. But we need research on long-term effects on the fertility status of soils. We are hoping to create a partnership in sustainable agriculture that will help other NGOs and farmer groups learn and experiment with these methods. We invite ILEIA readers to join us in this effort to create an alternative paradigm of sustainable agriculture. ■

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