USE OF ORGANIC MATERIALS AS FERTILIZERS

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Organic manures are of plant or animal origin and generally include green manure, compost, crop residues, farmyard manure and animal wastes. Commercial fertilizers are manufactured materials (organic and inorganic) supplying plant nutrients. Organic manures are bulky and the content of plant nutrients is low compared to commercial fertilizers (Table 1).

Table 1. Chemical composition of some organic manures and commercial fertilizers (%)

		Moisture	*N*	P_2O_5	K_2O
Cattle manure	...	50-85	0.60	0.15-0.40	0.3-0.6
Horse manure	...	78	0.70	0.25	0.55
Sheep manure	...	20-68	0.95	0.35	0.40
Pig manure	...	87	0.50	0.35	0.40
Poultry manure	....	55	1.00	0.80	0.40
Composts	...	—	0.60	0.3-0.6	0.2-0.8
Wood ash	...	—	—	—	3.0
Paddy husk ash	...	—	—	1.0	2.0
Coconut husk ash	...	—	—	2.0	20.0-30
Ammonium sulphate	...	—	20.6	—	—
Urea	...	—	46.0	—	—
Conc. super phosphate	...	—	—	42-46	—
Rock phosphate	...	—	—	27-30	—
Muriate of potash	...	—	—	—	50-60

The release of nutrients from organic manures is rather slow. It is estimated that only about one half of nitrogen, one sixth of phosphoric acid and one half of potash are available for crops in the season of application of the manure. On the basis of readily available nutrients, 1016.04 kg. of farmyard manure supplies approximately 2.27 kg. nitrogen .45 kg. phosphoric acid and 2.27 kg. potash.

Organic manures when applied to a soil :

(*a*) improve the physical condition and tilth of soils.

(*b*) increase water-holding capacity of soils and improve infiltration of rainfall.

(*c*) improve chemical characteristics and soil fertility.

(*d*) increase activity of the micro-organisms.

Organic manures improve the structure of soils. Improved structure leads to better aeration for root growth, promotes movement of water in the soil and increases the plant "available" water. Tilth is a term used to describe the fitness of a soil for the germination of seeds and growth of plants. Tilth describes soil structure in terms of the size, distribution of soil aggregates and the stability of the aggregates under tillage and rainfall. If the aggregates disintegrate after wetting and drying, a crust may form on the surface. Firm and thick crusts impede the entry of water, restrict aeration and hence reduce root growth. Such conditions could be prevented by using organic manures. Improved infiltration of rainfall reduces soil erosion.

In addition to the beneficial effects on the soil physical properties, organic manures improve the cation exchange properties of soils and also stimulate microbial activity by providing fresh substrates. The latter phenomenon provides plant nutrients through mineralization. It is possible that mineralization of organic matter which is a function of the microbial population releases micro nutrients in addition to the macro nutrients.

Mineralization of organic manures could also result in the release of substances which are of a growth promoting nature (hormones) as it has been shown that fulvic acid extracted from soil organic matter has some growth stimulating properties. Further, organic manures decrease fixation of phosphorous in soil and in some cases release the fixed phosphorous and make it available to plants. Organic manures differ from commercial fertilizers in that the nutrients they supply are released over an extended period so that fixation and leaching would be minimal. This could be advantageous under certain systems of agriculture.

The current recommendations for manuring rubber are made in conjunction with cultivation practices that would lead to the enhancement of organic matter in these soils. These cultivation practices are mulching, cover crops, allowing the old stand of the rubber to decay in the field etc.

Mulching

It has been established that mulching is advantageous to the growth of rubber and that the greatest benefit is obtained if used in the early years of a plantation. Mulching had been found to be very effective in not only avoiding evapotranspiration losses, but also in preventing run-off and soil erosion losses. Among some of the soil management practices that are practised in immature rubber plantations, dead mulch is known to increase the soil moisture storage capacity significantly in comparison with other practices such as growing leguminous cover crops, allowing naturals to grow or leave the land bare (clean weeded). Girthing of immature plants are also known to show similar effects with plants in mulch growing more vigorously than plants growing under other soil management practices. The cation exchange capacity of the soils are known to increase with mulching.

Leguminous cover crops

Many legumes, mainly *Pueraria phaseoloides* and *Desmodium ovalifolium* are grown in immature rubber, as they are known to improve growth mainly by promoting the accumulation of nitrogen and organic matter. Table 2, shows the nitrogen content and the C/N ratio of shown legumes and natural ground cover vegetation, from an experiment at the Rubber Research Institute of Sri Lanka. This shows the contribution a legume cover is likely to make with respect to nitrogen, in immature rubber fields.

Table 2. Nitrogen concentration (%)

and C/N ratio of plant material; 42 months from planting

Treatments	*Cover leaves*	*Green matter*	*Litter*	*Litter ratio, C/N*
Legumes	2.22***	1.46***	2.26***	12.09***
Naturals	1.60	1.03	1.65	22.26
L S D (P ≤ 0.05)	0.20	0.14	0.16	1.54

Moreover, the steep rise in the price of inorganic fertilizers have focused attention on research into biological nitrogen fixation in rubber plantations. Research on several aspects of this subject are in progress at the Rubber Research Institute of Sri Lanka.

Non-leguminous plants

The discovery in recent years of substantial nitrogen fixation in roots of tropical grasses by rhizosphere and rhizoplane microflora has stimulated interest in its research. As many grasses grow naturally under rubber the nitrogen fixing ability of such grasses should be investigated.

Animal wastes

The rubber industry do not generally use this material, primarily due to the non-availability of large quantities, which are needed by them. Nevertheless, many smallholdings of rubber (less than 10 acres) use cattle manure in the first 1-2 years of establishment. In the manuring of nurseries, the use of good compost at the rate of 5 tons per acre with 100 lb of Rock phosphate is still recommended where compost is available. In coconut estates, a common practice is to tether cattle or buffaloes at night in shallow trenches around the palms. It is usual to add the leafy portions of fallen fronds and other debris available before closing the trenches. Goat manure is used in sandy and gravelly soils. Goat manure is procured from two sources (i) on Estates and (ii) from Contractors. Goat manure does not contain sufficient amount of phosphoric acid and potash and these have to be added as supplements.

Cattle manure is very often a carrier of weed seeds and could be really problematic if used extensively without the parallel management practices. They could cause severe damage to crops by introducing termites, cockchafer grubs and other harmful insect pests as well as plant pathogens.

Animal bi-product

On some rubber estates it had been the practice to do most or all of the first two years of manuring with an organic fertilizer such as Animal meal. This appears to be successful but is expensive and is recommended as a practice only to those who can afford it. It is sometimes used in conjunction with one of the inorganic fertilizer mixtures.

It has also been the practice at the Rubber Research Institute of Sri Lanka, to recommend the application of 4 oz of Animal meal per planting hole, just before planting.

Crop residues

Regular prunings of tea plants and loppings of shade trees that are interplanted with Tea are known to return some nutrients to the soils, when they are put back in the soil. Similarly, in rubber plantations, annual leaf, branch and fruit fall are likely to make a great contribution in this regard. The estimated nutrient content of the annual leaf fall is considerable (Table 3) and in terms of fertilizer equivalent the quantities of nitrogen are about double those applied annually in the normal fertilizer schedule.

Table 3. Estimated annual nutrient return in leaf fall and annual fertilizer application in rubber plantations

Element	*Kg per ha*	*Equivalent fertilizer, Kg per ha*		*Annual fertilizer application Kg per ha*
Nitrogen	45 — 90	98 — 197,	Urea	77
Phosphorus	3 — 7	25 — 58,	Rock phosphate	168
Potassium	10 — 20	20 — 40,	Potassium Chloride	84
Mangesium	9 — 18	62 — 124,	Kieserite	84
Calcium	60 — 120	200 — 400,	Rock phosphate	168

No estimation is available for the return of nutrients by branch fall, but it is likely that appreciable quantities are involved. The amounts involved in annual fruit fall of approximately 160 kg per ha, is however, small. These are normally not collected for redistribution but allowed to decompose in situ. The use of coconut husk which has a high content of potash is a common practice in coconut plantations. The usual practice is to burry the husks in pits. The husk could also be carefully burnt and the ash applied to the soil.

Socio — economic aspects of organic recycling

Generally, rubber smallholders, would be inclined to show great interest in organic recycling if they are made aware of its usefulness and proper training given to them in this respect. This is becuase most of the raw materials for organic recycling are available without cost on the farm or in the community. Moreover, labour is also available in the farm as in most cases the family labour is used. As a matter of fact, a few of them, who are aware of the usefulness of such practices, devote great attention to them.