RECYCLING OF AGRICULTURAL BI-PRODUCTS AND OTHER ORGANICS AS THE SOURCE OF SLOW RELEASE OF NUTRIENTS

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Low soil organic matter content of soils of the tropics affects structure and pore size distribution, water retention and movements, available water and nutrient retention capacity of soil. The natural organic matter cycle involving soil-Plant-animal eco-system plays a significant role in soil improvement, plant production and maintenance of environmental quality. Recycling of plant residues like crop residues, tree wastes, weeds and green manures, animal wastes including human wastes and slaughter house wastes, rural and urban wastes including sewage sludge, agro-industries biproducts like oil cakes, paddy husks and bran, begasse and press mud, saw dust, fruit and vegetables wastes, cotton wool and silk wastes, tea and tobacco wastes, fish meals and sea weeds have been recognised as organic resources and can be utilised for recycling. In the crops parts like coconut spaths, inflorescence stalks, coir dust can be recycled effectively, arecanut leaves, husks and leaf sheaths, male inflorescences, leaves and empty bunches and burnt husk ash, pods and leaf fall in cocoa, shade tree leaf litter in coffee, tea and cardamom plantations are all the available sources organics for recycling. Besides these, the inter, mixed and multiple cropping in the plantation crops directly and indirectly help in the build up of organic matter

in the soil and release of nutrients. In addition, upto 4 tons of organic materials per hectare is being internally recycled each year through under ground crop residues. The exudates of plant roots are reactive materials compared with humic substances and are also used as carbon source by soil microbes. They consist of carbohydrates, amino acids and organic acids.

Association of nitrogen fixing bacteria like Azospirillum and asymbiotic bacteria like Beijerinckia were found to be present in roots and root regions of most of plantation crops, viz., coconut, arecanut, cocoa, pepper and these organisms have potential to fix considerable amount of nitrogen in these crops by biological fixation besides Rhizobium in legumes.

Nitrogen is abundant but is the nutrient that most often limits crop and food production. A crop can accumulate upto 800' kg N/ha/yr. and normally absorb atleast 200 kg N/yr. if high yield are to be obtained. If all N in crops were derived from fertilizer at the efficiency of 25% then it would require only 64×10^9 kg fertilizer N/yr to grow enough food for global population. The energy required to manufacture this fertilizer is equivalent to 128×10^9 kg of oil or about 2% of world annual fossil fuel consumption. The current fossil resource is sufficient to atleast for 100 years at present level of consumption. If all fossil fuels are exploited it will be possible to meet global requirement for 1000 years. But the problem is the world industry and infrastructure is geared

to use only one fossil fuel namely the oil which is being consumed rapidly. Another problem is that these resources are confined to only a few countries and they want to conserve for their descendants. The third problem is the present consumption level omits future consumptions by regions that are currently underdeveloped. Although fertilizer N is profitable it is also expensive and much of the world is inhabitated by people who do not have any reserve of energy fossile fuel nor credit to buy fertilizer or technology. The only practical way of improving N nutrition of crops is by more officient recycling of agricultural biproducts and crop residues. Moreover, there is no benefit by mere nitrogen nutrition to crops if the soil is deficit in P, K, S, or other trace elementswhich also could be managed through organic recycling.

The organic recycling in the soil-plant-animal-soil eco-system is based on bioprocessing and bioconversion. Conversion of organic N, P and S to available mineral forms (NH_4, NO_3, PO_4, SO_4) occurs through the activity of micro organisms and is affected by these factors affecting microbial activity (temperature, moisture, pH etc.) as well as by the C/N, C/P and C/S ratios of decomposing plant residues. Eventually, biological turn over through mineralization-immobilization leads to the inter change of inorganic forms of N, P, S with organic matter. The application of plant and animal residues result in differential mineralization and immobilization of

nutrients. The N, P & S content in the residues, as reflected through the C/N, C/P & C/S ratios play major role in regulating the availability of these nutrients. The decomposition of Crops residues and organic wastes by micro organisms leads to the liberation of significant quantities of trace elements, thereby completing the micronutrient bio-cycle. In addition, organic matter is required as source of energy for molecular N fixation by micro organisms, accordingly the amount of N fixed by free living fixers will be influenced by the quantity of available energy in the form of carbohydrates. The process of denitrification is also affected by decomposable organic matter. Native organic matter or amended with large quantities of organic residues in the acid soils where Aluminium toxicity is a problem, gave low Al Conc. in solution and permit good root growth.

Increase in organic matter with continuous application of crop residues increases soil aggregate and stability. Release of variety of organic polymers, humic substances of low molecular weight, poly saccharides and poly monides bind the particles into micro and macro aggregates. Water use efficiency through the effective decrease in run off, high water retention in root zone and improved root proliferation and development, improved nutrition and better growth are some of the benefits.

In perennial plantation crops like coconut, arecanut, cocoa, pepper, cardamom, coffee, tea and rubber, the organic

recycling both in pure as well as mixed stand contribute significantly in the nutrient cycling since constant and continuous addition of organics by way of decayed roots, root exuadales, litter fall, weeds, shade tree litter fall, flower and fruit stalks, and also biproducts like coir dust, pulp, crushed fruit bunches etc. They contribute substantially to the annual nutrient fluxes of plantation crops. The effective recycling of these organics will go a long way in reducing fertilizer budget, making available of nutrient in slow and steady process and conserve water and increasing water use efficiency. The nutrient fluxes for different plantation crops are discussed in this paper.