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ANIMAL MANURE AS RAW MATERIAL FOR VERMICOMPOSTING

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Animal manure is one of the major underutilized resources in many countries. Animal manure mainly refers to excreta (dung) and urine along with the bedding material mixed with soil. Animal manure is available either in dairies, slaughterhouses or at the backyards of the houses (Mukund and Chavan, 2007). Along with other animal wastes and agro-industrial wastes, animal manure is creating an environmental problems like, dispensing foul odors, occupying vast areas, ground and surface water pollution etc. The manure generated by animal production is currently receiving a great deal of attention in the water quality arena. Adoption of better animal waste management practices can reduce the transport of nutrients and pathogens from animal farms to ground and surface water, which could improve the water quality.

Though the food production has been improved significantly since 1960's by successful implementation of high yielding variety seeds, fertilizers, pesticides and farm machineries, in the recent past farmers are facing problem of stagnant productivity due to deteriorated soil organic carbon status. To improve the organic status of the soil, farmers are now turning towards the age old practices of organic farming i.e. managing the crops with without the use of chemical fertilizers and pesticides.

Animal Manure

Most animal manure is the excreta (variously called "droppings" or "crap" etc) of plant-eating animals (herbivores) and poultry mixed with bedding material (often straw) and thus is heavily contaminated with their feces and urine. Animal excreta differ according to species, diet, environment and productivity of the animal. The amount of excreta produced by different species of animals ranges from 0.12-1.9 tons /year /animal.

Table 1. Dung production per animal per year (Dry weight basis)

Sl. No.	Species	Dung Production (tons / year)
1.	Buffalo	0.80 – 1.90 (1.39)
2.	Cattle	0.40 – 1.80 (1.10)
3.	Horse	0.40 – 0.60 (0.50)
4.	Pig	0.20 – 0.30 (0.25)
5.	Sheep and Goat	0.10 – 0.20 (0.15)
6.	Poultry	0.12 – 0.16 (0.14)

(Mukund and Chavan, 2007)

Nutrient Composition of Animal Manure

The most animal excreta contain undigested food beside digested food residues, waste mineral matter, shredded gut cells, voided gut microflora and foreign matter. Most of the time undigested protein and nitrogen of the protein digestion in the form of urea or uric acid are excreted in feces and urine respectively. Magnesium, calcium, iron and phosphates are also excreted in the feces. Most of potassium that is absorbed from gut finds its way in to urine. Wastes from ruminants differ in composition when compared to wastes of pigs and poultry.

Table 2. Nutrient composition in excreta of different species of animals.

Sl. No.	Types of Livestock	Dry Matter (%)	Ca (%)	Mg (%)	N (%)	P_2O_5 (%)	K_2O (%)
1	Cattle	18	0.37	0.53	1.74	1.70	0.60
2	Swine	18	0.21	0.54	2.27	3.10	1.80
3	Poultry	45	2.28	1.39	2.17	2.00	4.20
4	Sheep & Goat	-	-	-	0.65	0.50	0.03
5	Horse	-	0.26	0.49	1.07	2.10	3.60

(Mukund and Chavan, 2007)

Goat manure is known for its high nutrient composition. Regardless of the feed type goat excreta contains protein, fat and carbohydrate, 34, 8 and 13 grams per kilogram dry matter respectively. Goat and sheep manure contain more nitrogen and phosphorous than cattle manure. It is also known to supply more nitrogen to the plants (Balasubramanian, *et al.*, 2009). The concentrations of total C, P and K in goat manure vermicasts are higher than those in cattle manure vermicasts. Cattle manure vermicasts had a higher N content than goat manure vermicasts. Earthworm biomass and reproductive performance were higher in cattle manure than in goat manure. The cocoon production per worm in cattle manure is also higher than in goat manure. Cattle manure always provides more nutritious and friendly environment to the earthworms than goat manure (Loh, *et al*., 2005).

Animal wastes are the valuable sources of organic matter and plant nutrient such as nitrogen. Though these animal wastes are utilized as compost to sustain agriculture in the past, they are not fully exploited until recently due to non-availability of viable, eco-friendly, socially acceptable and farmer friendly technology. In the last few decades vermicomposting has been arising as a sustainable tool for the efficient utilization of agro-industrial and animal wastes, and to convert them into value added products for land restoration practices. Among the microbial fertilizer, bio-fertilizer and vermicompost, the use of vermicompost as an organic manure has become popular owing to its simple preparation, eco-friendly nature and easily available raw material.

Vermicompost as a Bio-fertilizer

Vermicomposting is a process where earthworms and microorganisms convert organic materials into nutrient-rich humus called vermicompost. It is basically a process of composting with earth worms (*Eisenia foetida; Eudrilus eugeniae; Perionyx excavatus*). It is pertinent to quote here the saying of the great naturalist, Charles Darwin -- "All the fertile areas of this planet have at least once passed through the bodies of earthworms".

Vermicomposting is done with the use of organic wastes like animal manure (cattle dung, sheep dung, horse dung, goat dung and poultry droppings), agricultural wastes (after harvesting and threshing of the produce), forestry wastes (wood-saw, peels sawdust and pulp), city leaf litter (Mango, guava, oranges etc from residential areas), paper and cotton clothes (Ninawe, 2008). Vermicomposts are finely divided mature peat-like materials with a high porosity, aeration, drainage and water-holding capacity and microbial activity, which are stabilized by interactions between earthworms and microorganisms in a non-thermophilic process (Edwards and Burrows, 1988). Vermicompost contain often three times more calcium, five times more nitrogen, seven times more phosphorus, and eleven times more potassium than ordinary soil. It is also rich in humic acids, which act as soil conditioner.

Animal Manure as Raw Material for Vermicomposting

Vermicompost of animal origin improves mineral nutrition of the soil and enhances growth and flowering in plants. Cattle and goat manure are most commonly used raw material to culture *Eisenia foetida.* C: N ratio, carbon content and NPK values of vermicompost can be improved by using different animal manure as a feeding material to earthworms, instead of using dung only. In a research, it has also been shown that the vermicompost from goat manure using the earthworm *Eisenia foetida* is better than the vermicompost from other animal manure (Perez, *et al*., 2005). Addition of manure has been shown to be of critical importance and determines most of the changes that takes place during vermicomposting process (Aira and Domínguez, 2008).

Advantages of Vermicompost Over the Organic Manure

The available nutrients are more in vermicompost as compared to farmyard manure (Galli, *et al*., 1990).

Secretions of earthworms contain plant growth factors such as auxins and giberllic acid, which stimulate roots to grow faster and deeper (Galli, *et al*., 1990).

In presence of vermicompost, the uptake of added inorganic nutrients by soil improves (Shi-Wei and Fu Zhen, 1991).

Microbes present in the vermicompost inactivate and suppress the growth of pathogens (Kale, 1998; Shobha, 2005) and thus prevent soil-born plant diseases (Hoitink and Fahy, 1986).

Vermicompost has the capability to suppress plant parasitic nematode populations (Johnston *et al*., 1995).

Vermicomposts consistently promote biological activity, which can cause plants to germinate, flower, grow and yield better than manure, independent of nutrient availability (Atiyeh, *et al*., 2000 a, b).

Vermicompost contains most nutrients in plant available form such as nitrates, phosphates and exchangeable calcium and soluble potassium (Edwards, 1998; Orozco *et al*., 1996).

CONCLUSION

Gradual transformation from subsistence farming to intensive farming witnessed the increase use of high yielding variety seeds, fertilizers, herbicides and pesticides in order to meet the increasing demand of food, fuel and fodder of human and animal kind. The indiscriminate use of advance technique fail to maintain the soil productivity and thereby sustainability. This necessitated the exploitation of vermicompost as alternative source of plant nutrient. Vermicomposting predominantly uses earth worms to digest the waste, rather than microorganisms. Earth worms being the best friend of the farmers, play a variety of important roles in agro-ecosystem as they feed on organic wastes like agricultural wastes, several domestic wastes, livestock manure and green plant materials. As a feeding material, animal manures are of immense value owing to their high carbon content, C: N ratio and NPK values.

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