MR VERMICOMPOST

A product of integrated farming system

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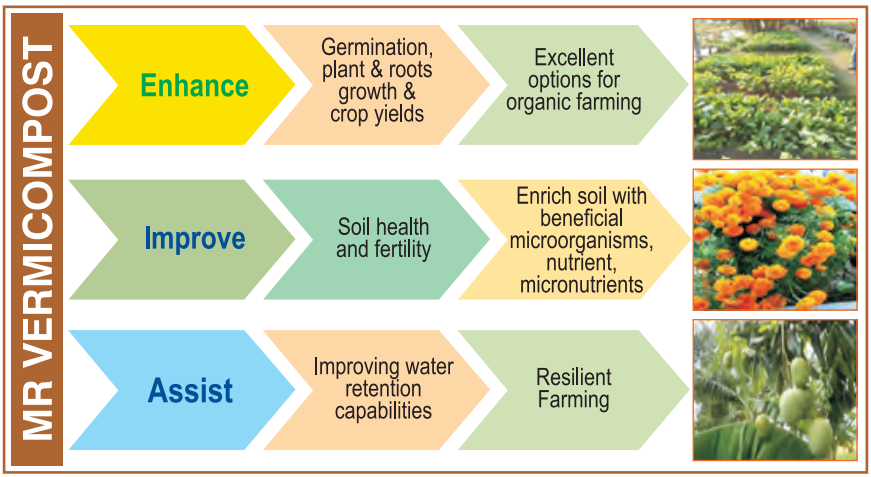

Integrated farming system (IFS) generates lot of biomass residues round the year. In principle these residues are to be suitably recycled within the farming systems to meet the nutrient and energy requirements of enterprises (IFS) for enhancing productivity. Out of various method of practices of residue recycling, the vermicomposting is one of the most efficient ways to convert farm wastes (agricultural waste and crop residues) to valuable nutrient rich fertilizers for plant growths. The Multi Resource Vermicompost (MRV) is a organic fertilizer product of IFS prepared by utilizing various agricultural, livestock, horticultural and agroforestry wastes generated/available in the rice based integrated farming systems through the bio-oxidative degradations accomplished by the synergistic actions of earthworms and microorganisms. The organic manure prepared from the use of multiple farm resources (Table 1) not only provide higher levels of organic carbons and available plant nutrients, but also bearing several plant growth promoting substances (i.e. enzymes, vitamins and hormones) and beneficial microorganisms which helpful in healthy and better plant growth. Additionally, it has varied inert characteristics potentials of suppression of plant diseases and soil borne pathogens.

Table 1. Agricultural residues available in crop-livestock-agroforestry based integrated farming systems and their characteristics.

Agricultural residues	Nutrient contents*			Absorbency	Bulking potential	C:N ratio
	N %	P_2O_5 %	K_2O %			
Rice straw	0.5 - 0.8	0.18 - 0.20	1.4 - 2.0	Poor	Medium-good	150 - 160
Green gram residues	1.20 - 1.29	0.08 - 0.1	0.34 - 0.39	Good	Medium	18 - 22
Vegetables residues and stubbles (brinjal, tomato, cow peas, radish, okra, pumpkin, bottle gourd, snake gourd, chilly, papaya, turmeric, ginger, Colocasia etc.)	1.85 - 3.18	0.35 - 0.49	1.52 - 2.85	Good	Medium	10 - 17
Banana pseudo stem	0.71	0.22	2.21	Good	Poor-medium	45 - 50
Leaves litters of mango, guava, coconut & acacia plants etc.	1.2 - 1.6	0.15 - 2.0	1.05 - 1.35	Poor-medium	Poor-medium	30 - 70
Horticultural fruits	0.85 - 2.47	0.5 - 0.8	2.6 - 3.1	Good	Medium	20 - 49
Weeds biomass	2.3 - 6.88	-	-	Good	Medium	10 - 30
Fodder grass	2.3 - 6.1	-	-	Good	Medium	15 - 20
Poultry droppings	2.5 - 3.0	1.0 - 1.13	0.7 - 1.2	-	-	5 - 7
Duck droppings	0.95	0.54	0.37	-	-	25 - 30
Goat droppings	2.5 - 3.0	0.3 - 0.4	1.5 - 1.7	-	-	30 - 36
Cow dung	0.8 - 1.2	0.2 - 0.4	0.3 - 0.6	-	-	20 - 25
Farm yard manure	0.4 - 1.5	0.3 - 0.9	0.3 - 1.9	-	-	20 - 25

*Nutrient values expressed in dry wt. basis.

Methods of preparations

Organic farm wastes, suitable earthworms and water are the three basic requirements for production of MR vermicompost.

- An area under shade of tree or thatched house, having high humidity and cool places with provisioning of suitable protections from direct sun, extreme temperature (i.e. freezing or high temperature) and close to the fish pond was selected.
- The plastic containers or bag of height of 2½ feet and a breadth of 3 feet were used for preparation of compost, however, length may depend on the size of the room.
- Vermicompost can also be prepared either in pits (dug below the ground) or in raised heap (above ground), or circular/rectangular cemented structure or containers like wooden boxes, plastic buckets or vermiculture bags having provision of water draining hole at the bottom for draining excess waters.
- On the floor of the bed one layers of broken bricks, mixed soil and sand are spread uniformly (2-3 inch thickness).
- After this a layer of neem or pangamia (karanj) leaves are applied for preventing and discouraging the ants and termites infestations.
- Agricultural wastes materials generated from IFS, i.e.crops and livestock's including horticulture, agroforestry, vegetables and fodder etc. were collected, sun dried and chopped into suitable size (bedding materials).

Fig. 1. Some of the crop residues of IFS

Fig. 2. Picture depicting cemented structure vermibed (A), Plastic vermibags for vermi composting (B), Earthworm species *Eisenia foetida* (C), Vermicompost final product (D).

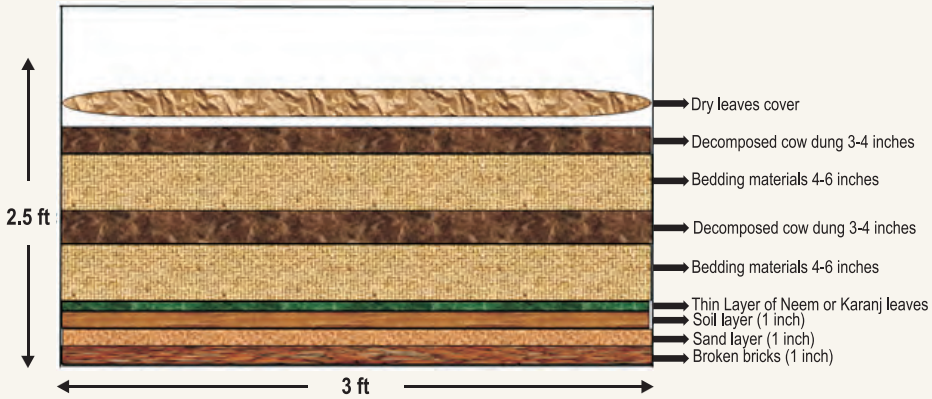

Fig. 3. Cross sectional view of Vermicomposting bed with different spreading layers.

- The bedding materials of 4-6 inches are sprayed with a layer of cow dung slurry (bulky substrate). This is followed by a 2nd layer of decomposed cow dung (3-4 inches thickness) spread uniformly over the bedding materials. This process layering of organic waste and dry cow dung are repeated until the container is filled up or desired level.
- After 15-20 days of pre-conditioning (spraying of water for moisture and turning of heap 2-3 times at 4-5 days intervals), the earthworms are released at the rate of 1 kg earthworms /m^2 of heap.
- Adequate water spraying is essential for maintenance of moisture levels in the compost heap.
- Efficient debris consuming, non-borrowing earthworms (*Eisenia foetida*, *Eudrilus eugeniae*, *Eisenia andrei*, *Perionyx excavates* are ideal for vermicomposting)
- Once in every 15-20 days, the heap of organic wastes are turned upside down for efficient conversion and covered with gunny bags for moisture retention and protect from predators like birds and other animals.
- For complete conversion of organic wastes to vermicompost needs 2-3 months and also depends on favorable conditions (moisture, temperature, aeration, pH value, ammonia and salt contents) and density of worms etc.
- The approximate turnover of the compost is 50 - 75% of the organic residues loaded (i.e. if one tons of organic materials loaded expected vermicompost will be 500-750 kg). The harvesting of vermicompost can be done by using manual, or making pyramidal heap, screening or sieving methods or inducing the migration of worms.
- The vermicompost are stored in dark and cool places and packed in a laminated sac/bag prior to selling. Vermicompost can be store for longer period (1 year) without compromising qualities (nutrients and beneficial microbial population) with maintenance adequate moisture (40% of levels) and aerations.
- The physical and chemical composition of the compost is determined by following standard laboratory methods.

Fig. 4. MR Vermicompost

Nutrient values of MR Vermicompost

The MR Vermicompost are rich in nutrient contents along with diversified beneficial micro-organisms and other growth promoting substances (Table 2 and 3).

Table 2. Nutritional composition of MR Vermicompost.

Nutrient contents in MR Vermicompost*	
pH	6.12 - 7.5
EC dSm^{-1}	3.1 - 3.9
Total Organic carbon, %	9.10 - 18.83
Total Nitrogen, %	1.9 - 3.3
Total Phosphorus, %	0.5 - 1.9
Total Potash, %	0.9 - 2.1
Calcium, %	0.5 - 1.5
Magnesium, %	0.2 - 0.4
Sulphur, ppm**	100 - 550
Iron, %	0.9 - 1.7
Copper,ppm	2.1 - 9.4
Zinc, ppm	5.2 - 10.7
Manganese, ppm	1000 - 2000

* Values may vary depending upon the type of organic waste used.
**ppm parts per million

Table 3. Total microbial count in MR vermicompost using *Eisenia foetida*.

Groups	Total microbial count (CFU/gm)
Bacteria (10^7)	3.3 - 4.1
Fungi (10^6)	1.2 - 1.6
Nitrogen fixer (10^7)	3.3 - 3.9
Phosphate solubilizer (10^4)	2.1 - 2.7
Actinomycete (10^4)	1.6 - 2.2

CFU- colony-forming units

MR Vermicompost uses and its beneficial effects

Vermicompost can be used for any crops, however, its use is most profitable in the case of commercial crops like horticultural and fruit crops, ornamental plants, & vegetables and flower cultivations including kitchen gardening etc.

Table 4. Dose, time of application and yield advantage of different crops applied with MR vermicompost.

Crops	Quantity to apply	Time to apply	% increase in yields
Rice	1.0 - 2.0 tons/Acre	After transplanting	5 - 8
Sunflower	0.4 kg m^{-2}	Last ploughing	5 - 8
Chilli	0.25 kg m^{-2}	Last ploughing	8 - 10
Maize	0.25 kg m^{-2}	Last ploughing	5 - 8
Turmeric	0.25 kg m^{-2}	Last ploughing	10
Flowers	0.075 - 0.1 kg m^{-2}	Applied around the plant and covered with soil before irrigation	10 - 12
Fruits trees (guava, mango, banana)	0.075 - 0.1 kg m^{-2}	Every year depending on age of trees	5 - 10
Vegetables onion, tomato, cow pea, bhendi, radish, brinjal, cabbage etc.	5.0 - 10.0 kg $tree^{-1}$	Last ploughing and during vegetative growth	12 - 15
Banana	0.25 - 0.375 kg m^{-2}	At the time of planting	15
Teak, acacia magnesium	0.5 - 0.75 kg $plant^{-}$	At time of planting and once every year	10 - 15 higher growth

Economics

➢ Agricultural waste generated from the IFS can be suitably utilized through vermicomposting for production of quality fertilizers MR vermicompost for use in agriculture

and horticulture. The protein rich worms become pro-biotic food for fish culture and livestock production (dairy, goatry, duckery and poultry etc.). In crop-livestock-agro forestry based integrated farming systems (1 hectare area), a vermicompost unit consisting of 5 vermi bags (size 12' x 3' x 2.5') can be operated from a thatched house (25' x 15'). The duration of one cycle of MR vermicompost is approximately 110 days. Maximum of three cycle can taken in one year periods, however, depending on availability of organic residues two cycle of vermicomposting will be beneficial with annual targeted production capacity /year of 8 tonnes (800 kg x 5 units x 2 cycle = 8000 kg). The cost benefit ratio of MR vermicompost is 1:3.4 (Table 5).

Table 5. Estimated capital investment and profits of vermicompost unit under IFS.

Input materials	Quantity	Rate (Rs.)	Amount (Rs.)
Depreciation cost of thatched house using bamboo and rice straw	1 Nos.	2000	2000
Depreciation cost of Vermi bed (5 yrs life span)		550	2750
Organic residues (available in crop-livestock agroforestry IFS system)	–	–	–
Cow dung and droppings of other livestocks available in crop-livestock agroforestry IFS	–	–	–
Labour requirements (material processing and filling, 1 MDY/bag, watering, 1 MDY/bag, harvesting and packing and sale etc., 2 MDY/bag. Total = 4 x 5 x 2 cycle = 40 nos.	40 Nos.	300	12000
Procurement of Vermi worm (initial)	10 kg	400	4000
Total production cost	–	–	20,750
Output			
Vermicompost production	8000 kg	10	80000
Sale of vermin worm	40 kg	300	12000
Total returns	–	–	92000
Net profit			**71,250/-**
Benefit cost ratio			**3.4**

Benefits

- Reduces quantity of organic wastes, converted to high quality organic fertilizers and providing safe ecological environments.
- MR Vermicompost is prepared from multi resource organic wastes, hence, it is qualitatively better fertilizers for plant growth.
- Application of MR Vermicompost improves the soil quality (i.e.physico-chemical constituents and biological properties with soil enrichment of micro-organisms).
- Reduces the needs for synthetic store purchased product.

- MR Vermicompost increases the crop yield and reduces the dependence on application chemical fertilizers.
- Suppresses the varied plant diseases and soil borne pathogens.
- Freshly harvested MR vermicompost having higher concentration of diversified beneficial microorganisms helps in enhancing crops growth and productivity.
- Reduces GHG emissions.

Up scaling

The IFS farmers can go for production of such type of vermicompost from their system by taking leverage of state Govt. scheme under National Food Security Mission (NFSM) and National Horticulture Mission (NHM) through availing the subsidies to beneficiaries. The vermicompost produce can be utilized in the system and surplus can be marketed giving additional return/benefits to farmers.

TechNRRI

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