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VERMITECHNOLOGY AS AN ECOFRIENDLY APPROACH FOR INTEGRATED FARMING

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ABSTRACT:

Today farmers and farming system are facing number of problems, so the integrated farming supporting as one way to solve all these problems through vermitechnology by vermicomposting, vermiwash and vermiculture to develop sustainable, profitable and eco-friendly farming system and a little bit economic contributory to farmers. In order to cope up with this from January 2019 to December 2021, it was found that vermicomposting serve as a biologically integrated farming system which integrates natural resources and regulation mechanisms into farming activities to achieve maximum replacement of off-farm inputs, secures sustainable production of high quality food and other products through ecologically preferred technologies, sustain farm income, eliminates or reduces sources of present environment pollutions generated by agriculture and sustains the multiple function of agriculture. In turn it provides round the year income to the farmers, eco-friendlytechnologiesas alternative to pesticides, synthetic fertilizers and agro pollutants through vermiwash, vermicompost and vermicultures. Two pairs of vermicompost cement tank bed with size 4'x3'x12' is sufficient for 4 hectare farm to fulfil all needs of farm and farmers and may serve as small scale eco-friendly agroindustry. During the study period it was found that single pair of vermicompost tank provide 963kg of Vermicompost, 521kg vermiculture and about 698 ltr of Vermiwash which serves as good agricultural practice (GAP), which provide continuous source of income from agrowaste to agrobest for farmers with number of eco-friendly advantages.

KEY WORDS: Vermitechnology, Vermicompost, Vermiculture, Vermiwash, Agrowaste, Agrobest, GAP, etc.

INTRODUCTION:

In conventional agricultural green revolution system, agricultural fertilizers and pesticides increasing tremendous pressure on farm land such as over intensive monoculture cropping resulted into loss of fertility, micro-fauna and nutrient of the soil, which created serious problems on agro-ecological sustainable balance and nutrient cycles of the soil. It adversely affected human health; when fertilizers and pesticides are used in farmlands, they are transmitted directly or indirectly into the corns and vegetable that affects the human health. Moreover, as pesticides are applied over the vegetable which are directly entered into human or livestock bodies. Excessive use of fertilizers may pollute the underground water with nitrate and it is so much hazardous to humans or livestock. Nitrate concentrated water can

immobilize some of haemoglobin in blood. Organophosphate pesticides have increased in application, because they are both less persistent and harmful for environment than organochlorin pesticides. But, they are associated with acute health problems, such as abdominal pain, dizziness, headaches, nausea, vomiting, as well as skin and eye problems. There have been many studies intending to establish cancer – pesticides association. Organophosphate pesticides used in the vegetables gradually get deposit into human body and has a link with cancer (Miah et al. 2014). Therefore, there is need for making changes in agricultural system to overcome these problems through IFs vermicompost revolution, which is ecofriendly, sustainable and profitable agriculture.

To build long-term soil fertility, to produce healthy, balanced and quality agro-product, clean and pollution free environment, recycling and conservation of the resources of the soil are important, therefore solution is necessary. The use of vermicompost, will definitely add relevance in solving these problems.

Production of better alternative to reduce chemical fertilizers and pesticides formulations is an answer to this destruction phase. Now it is a well-established fact that there is the foremost need to step forward towards our mother earth by nurturing it by going for the organic farming system. An answer to this havoc is the organic farming, an environmentally friendly agricultural approach which ultimately leads to proper human health. Moving back to our ancestor's course by performing organic agriculture is a step towards sustainability. Organic agriculture is a holistic production and management system which is supportive of the environment, health and sustainability (Dubey, 2013).

Vermicomposting has gained popularity in both industrial and domestic settings because, as compared with conventional composting, it provides a way to treat organic wastes more quickly. In manure composting, it also generates products that have lower saline levels. It contains water soluble nutrients-rich fertilizer and soil conditioner in an ecofriendly form that is relatively easily absorbed by plants. It also reduces the waste of agro-farming, keep the environment clean. Enhances the productivity of the crop yield. Thus by digesting the agro-waste prevent pollution of air and water. It also provides employment for production and marketing. Thus create round the year income generation and provide entrepreneurship to the farmers.

MATERIALS AND MEHTODS:

Vermitechnology is the science of vermicomposting, vermiculture and vermiwash. Worms can eat biodegradable organic waste equal to their body weight each day, leaving castings as the by-product. Worm castings are called vermicompost. Two cement tanks constructed to a height of 3 feet and a breadth of 4 feet and the length 12 feet with 3 feet distance between them as it allows free movement for harvesting and other labour work. The bottom of the tank is made to slope like structure to drain the excess water from vermicompost unit. A small sump is necessary to collect the drain water as well as Vermiwash 12 to 14 hours after draining excess water during peak period of worm culture.

Segregation of decomposable and indecomposable, dry and wet material obtained from farming, which includes farm residues such as leaf litter, grass cuttings, forest litter, dried chopped crop residues etc. as well as mixture of leguminous and non-leguminous crop residues enriches the quality of vermicompost and allowed it to partial decompose for 15 days. This composition includes 40% green wet waste, 40% dry waste and 20% other materials like cattle dung, coir waste, saw dust, sugarcane trash and soil, Introducing the Vermi Worms, Red wriggler *Eisenia foetida*. After 15 days upon putting the substrates into the vermi beds, we introduce the 5 kg of vemiculture into the substrate. We used the Red wriggler *Eisenia foetida* in our vermibed. Aerobic decomposition lasts for 25-28 days

depending on the materials used and the ratio of the worms to the substrate. In our case, we have a total of 300 to 400 kilograms of substrate each bed enough to feed a 5-6 kilogram of worm for four weeks. Within the period, we moistened the substrate regularly to provide the right moisture (60 - 80%) for the worms to grow and multiply. Vermicompost were collected after 45 days of culture and regularly at 8 to 10 days interval with vermiwash upto 3/4th biodegradation of organic waste and simultaneously vermiculture collection at maturity.

RESULT AND DISCUSSION:

The present study deals with vermitechnology and to make agriculture a remunerative enterprise enough with farmer's optimism, positive outlook and initiatives by implementing integrated farming systems through vermitechnology as it converts agrowaste into agrobest as vermicompost, vermiwash and vermiculture. The earthworms consume the soil organic matter and convert it into humus within a short period of time and increase the soil fertility (Sujatha et. Al. 1999). Worm casting contains 5 times the available nitrogen, 7 times the available Potash, and 11/2 times more calcium than found in upper layer of the soil. The vermitech approach utilizes waste management process by involving earthworms (Satchell, 1967). As shown in Fig. 1(1) all the biodegradable waste collected and filled into vermibed for about 15 days, then as in fig.1(2)introduction of vermiculture that is Eisenia foetida, very common large sized, epigeics, prolific breeder and efficient in recycling of organic material in to vermicompost, When biodegradable organic waste is completely decomposed it appears black and granular as in fig. 1(3), watering should be stopped as compost get ready, which is sieved in 2 mm sieve as in Fig. 1 (4), the material passed through it is the vermicompost, which was collected as shown in fig.1(5).

Vermicompost:

The average production of vermicompost 321kg/year in a single vermicompost tank bed (size 4'x3'x12') as shown in table 1 (fig. 2). Maximum collection of vermicompost noted during July to November months during the study period from January 2019 to December 2021. This shows that July to November are the most favourable period for the vermiculture during which it become very active. Thus the total production of vermicompost during the study period was 963kg in a single vermibed, which increases the income source of the farmer. In conventional farming income is expected once at the end of cropping season, however integrated farming through vermicomposting provides flow of money round the year. Misra (2003) proposed that worms can consume practically all kinds of organic matter and they can eat their own body weight per day, e.g. 1 kg of worms can consume 1 kg of residue every day. The excreta (castings) of the worms are rich in nitrate, available forms of P, K, Ca and Mg. The passage of soil through worms digestive system promotes the growth of bacteria and actnomycetes. Actinomycetes thrive well in the presence of worms and their content in worm casts is more than six times that in the original soil. Whereas, Aalok (2008) reported that the vermin culture serves as natural bioreactors for cost effective and environmentally sound waste management.

Tripathi et al (2005) reported about American Resource Recovery (ARR) in Westley, California operates the largest vermicomposting facility in the United States. The vermiculture operation was begun in 1993 to build an earthworm inventory through windrows method; four years later, ARR began processing and selling vermicompost. Currently, an estimated 500,000 pounds of earthworms process 75,000 tons of materials annually on 70 of ARR's 320 acres. The worms are fed paper pulp generated from recycled cardboard, tomato residuals, manure, and green waste in three-foot wide windrows, some of which are a quarter mile long. During its busiest season, ARR ships up to 100 tons

of vermicompost per week. In 1998, they began selling earthworms throughout the United States, and expanded to foreign markets in 1999.

Vermiwash:

During the study period in addition to vermicompost, it also produce vermiwash as a biopesticide, plant growth nutritive honey brown coloured as in fig.1(6-7) liquid sub product which has value in market, it was on an average 19 ltr per month and in peak period from july to October at maximum up to 30 ltr per month table 1 (fig.2) for a single pair of vemibed and it was found very effective against Abrusprecatoris bugs. Jayabhaye and Bhalerao(2015) opined that the vermiwash is a honey brown coloured liquid extract of organic composts, generally the wash of earthworms Present in the medium collected after the passage of water through the different layers of worm culture unit.

Nayak et al (2019) reported the effect of vermiwash on the plants and soil, it was found that vermiwash seems to possess an inherent property which acts not only as a liquid organic biofertilizer which promote growth of plants and yield but also as a mild biopesticide. So, it can be used as a potent input in organic farming and sustainable crop production for both soil health and insect, pest and disease management.

As well as Khan et al (2014) investigated the effect of a vermiwash foliar spray on the response of bhut jolokia (Capsicum assamicum) exposed to two different arbuscular mycorrhizal fungi (AMF: Rhizophagus irregularis, RI and G. mosseae, GM) in acidic soilunder naturally ventilated greenhouse conditions. The VW spray significantly influenced the growth of plants receiving thedual treatment of AMF+VW.

Jaikishun et al (2014) studied the effect of vermiwash in controlling fungal diseases and growth of tomato and mentioned that it is beneficial to get rid of pathogens and promote growth of the plant.

Vermiculture:

Present research work carried only on Eisenia foetida as it is very common, large sized, epigeics, prolific breeder and efficient in recycling of organic material in to vermicompost as in fig. 1 (8-9). In a single pair of vermibed produced 521kg per year table 2 (fig.2), it showed at most collection of vermiculture in the December and on an average it was 145 kg at the end. Pattnaik and Reddy (2010) found that the number of worms produced per cocoon was higher in *E. foetida* than that of *E. eugeniae*and *P. excavates;* while the number of cocoons collected at the end of the experiment was more in *P. excavates* by than that of *E. eugeniae* and *E. foetida* in market waste; that of *E. eugeniae* and *E. foetida* in floral waste, respectively. The number of juveniles collected was higher in *P. excavates* than that of *E. eugeniae* than that of *E. foetida* in market waste, whereas the increase in *E. eugeniae* and *E. foetida;* The mortality rate of the *P.excavatus*was higher than that of *E eugeniae* and higher than that of *E. foetida* grown in market waste, while it was higher than *E eugeniae* and *E. foetida* grown in floral waste; the number of worms per cocoon was higher in *E. foetida* compared to other species

In the economic point of view this vermitechnology may serve as an integrated farming which was eco-friendly and also as a small scale industry contributing to up-liftment of farmers, in connection with this Kumar S et al (2021), Sinha et al (2009) and Deokota et al (2014) studied the economics of vermicompost production and marketing showed that it is profitable enterprise with better net profits and benefit cost ratio to the farmers. Further reported that the direct marketing of vermicompost from producer to consumer was found to be the strongest marketing channel however marketing through cooperatives and trader was also found in few instances. Marketing through cooperatives was found to be more efficient as compared to marketing through trader because both producers' share and marketing efficiency index was higher for former

as compared to later. From the financial viability study we can conclude that vermicompost production is feasible enterprise.

Fig. 1: Different Stages of vermicompost, vermiwash and vermiculture collection.
1. Collection and filling of vermibed by organic waste, 2. Release of vermiculture, 3. Vermicompost ready for screening, 4. Screening of collected vermicompost, 5. Collected vermicompost, 6. Collection of vermiwash, 7. Storage of vermiwash in airtight container box, 8. Growth and length of vermicultuture, 9. Collection of vermiculture

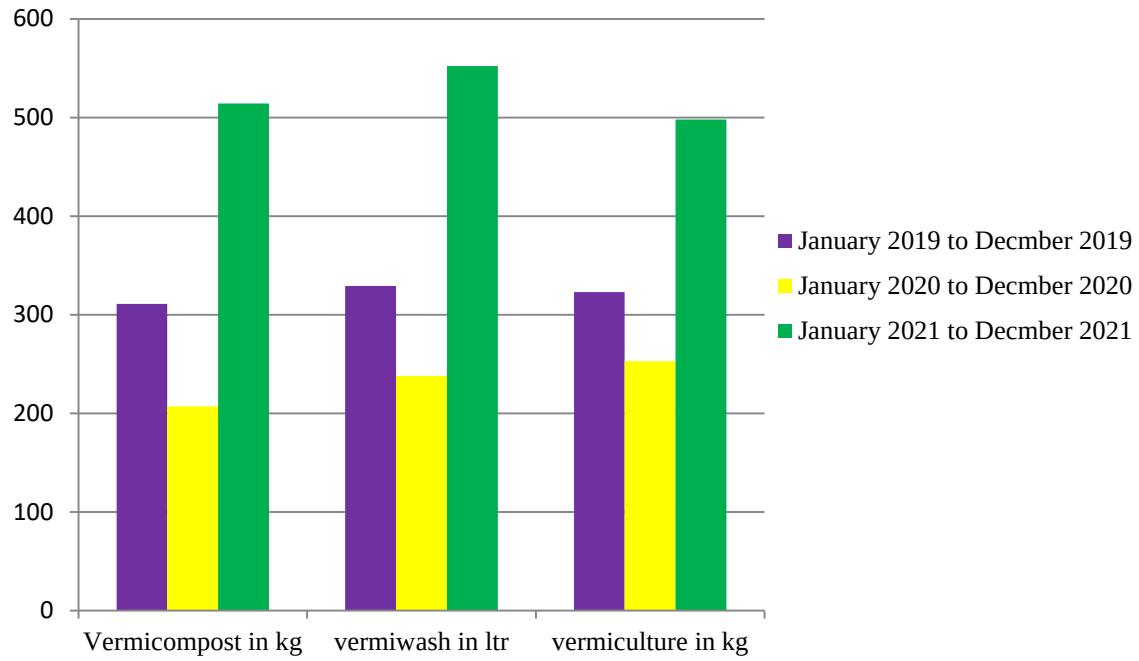
Vermitechnology	Vermicompost in kg			Vermiwash in liter			Vermiculture in kg		
Month /Year	2019	2020	2021	2019	2020	2021	2019	2020	2021
January	20	22	22	10	12	12	5	6	5
February	18	24	23	8	11	14	6	8	7
March	16	26	25	12	13	15	12	13	10
April	14	12	14	14	15	14	14	15	12
May	11	12	12	10	12	12	20	24	18
June	28	29	26	18	24	26	22	26	26
July	37	36	30	22	32	30	38	42	30
August	34	33	35	28	33	30	40	45	32
September	30	35	29	26	28	29	42	63	58
October	38	38	42	23	26	27	86	65	64
November	40	39	45	21	20	26	87	89	98
December	25	23	20	15	12	18	142	156	138
Total	311	329	323	207	238	253	514	552	498

Table1: Vermitechnology output as vermicompost, vermiwash and vermiculture month wise production from January 2019 to December 2021.

Vermitechnology and Year	Vermicompost(kg)	Vermiwash(ltr)	Vermiculture(kg)
January 2019 to Decmber 2019	311	329	323
January 2020 to Decmber 2020	207	238	253
January 2021 to Decmber 2021	514	552	498

Table2: Vermitechnology output as vermicompost, vermiwash and vermiculture year wise production from 2019 to 2021.

Figure2: Vermitechnology output as vermicompost, vermiwash and vermiculture year wise production from 2019 to 2021.



CONCLUSION:

Present study tried to make agriculture a remunerative enterprise or as a secondary support of income to farmers through Vermitechnology and it isenough with farmer'swillpower, optimism, positive outlook and initiatives by implementing integrated farming systems through vermitechnology as it converts agrowaste into agrobest by vermicompost, vermiwash and vermiculture.

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