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Minerals Rich Organic Manure (MROM)

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Abstract: Indiscriminate use of synthetic chemical fertilizers over past few decades in India and other countries of the world, has become a cause of great concern to maintain long term soil fertility, the soil environment, and its components. The soil microbial community plays a major and important role in fostering soil health and plant growth. While the use of synthetic chemical fertilizers has a profound impact on plant growth, it significantly alters the structure of the microbial community towards a detrimental degradation.

Sustainable farming practices help in reducing the depletion of natural resources and maintain both productivity and soil fertility. The use of natural minerals that contain fertilizer nutrients in their native state is a very promising approach to reducing emissions associated with the manufacturing industries. Organic material from natural sources (biodegradable agricultural waste, food waste, Cow Dung, Gomutra (Cow Urine), etc.) and the waste obtained from saturated filters of Bunkerman CO2/TVOC Removal Systems, acts as a source of microbial culture and encourages the release of nutrients into the soil during mineral weathering. The combination of nutrient based minerals and their biological weathering agents together with organic matter, has the potential to remediate, restore, and sustain depleted agricultural soils.

In the present invention, four types of "Minerals Rich Organic Manures (MROM-1 to MROM-4)" have been manufactured by making use of the waste obtained from saturated filters of Bunkerman CO2/TVOC Removal Systems, the biodegradable agricultural waste, Cow Dung, Gomutra (Cow Urine) and other important minerals like Rock Phosphate, Zeolite, Bentonite, Gypsum, Kaolin, Carbon, Silica etc, available in nature.

The emphasis has been on the significance of sustaining agricultural productivity and microbial diversity in the rhizosphere, the region of soil in the vicinity of plant roots in which the chemistry and microbiology is influenced by their growth, respiration, and nutrient exchange.

Keywords: mineral fertiliser, organic manure; sustainable farming; pollution, microbes, phosphate

I. INTRODUCTION

It is a well-known fact that normal atmospheric air generally contains 79.03% Nitrogen, 20.94% Oxygen and 0.03% Carbon dioxide by volume. Nitrogen is not absorbed by lungs. Exhaled air contains an average of 4.38% Carbon dioxide [1,2,3]. It is a well known fact that the carbondioxide (CO2) level in the atmospheric air was naturally maintained around 280 ppm over the past many centuries till about 1776 or a little later until beginning of the Industrial Era. However, due to industrial revolution, the CO2 level has started increasing exponentially over the past few decades and it has already reached a world average of about 420 ppm. If it is not controlled by innovative solutions, it is likely to cross a figure of about 520 ppm by the year 2050.

To overcome the above problem of CO2 increase, Bunkerman in India, has recently invented an indigenous technology for which the patent has been filed vide Docket No 128656 dated 17 Nov 2022 with Controller General of Patents, Designs & Trade Marks, India [1,2]. It is observed that when the CO2, TVOC and other pollutants are absorbed/adsorbed in the filter material of Bunkerman a reasonably high value minerals and compounds are generated inside the saturated filters[1,2]. On saturation the filters may be replaced by the new filters and the saturated material of old filters can be utilised as a raw material to obtain "Minerals Rich Organic Manure (MROM)" by mixing and reacting it with other organic materials and compounds such as biodegradable agricultural waste, Cow Dung, Gomutra (Cow Urine), Rock Phosphate, Zeolite, Bentonite, Gypsum, Kaolin, Carbon, Silica etc.

Minerals are also an important component of the soil; they are the skeleton of the soil and the source of mineral elements[4]. Minerals play an important role in the improvement of soil's physical and chemical properties and the growth and metabolism of microorganisms [5 to 8]. However, the beneficial effects of the use of appropriate minerals in the soil have long been neglected. In addition, our research has found that forms of mineral weathering, such as silicate weathering, are often accompanied by the formation of secondary carbonate minerals in the process of biological weathering, which undoubtedly increases the potential of cultivated soil carbon sinks.



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Further studies have shown that secondary minerals formed with mineral weathering have a good remediation effect on heavy metal pollution[9,10]. In addition to the formation of secondary minerals, the cations released by mineral weathering can also combine with the soil's organic complexes through co-precipitation, which in turn mediates the formation of soil aggregates, preserving soil organic carbon, thereby reducing the potential of soil carbon depletion. Therefore, "Minerals Rich Organic Manure (MROM)" has a positive impact on agriculture, soil health and the ecological environment. It provides a new vision and a new dimension for the development of sustainable agriculture in line with reducing the environmental pollution and help in arresting the climate change and global warming.

II. EMBODIMENT

A. Embodiment 1

<u>MROM-1</u>. The material obtained from the saturated BUNKERMAN filters has been found to contain a high value of minerals like N, P, K, Ca, Mg, S, C etc. The constituent and composition depends on the design of the filter adopted and the area in which it has been used. The constituents of the filters used in residential area may well differ from those used in industries and high toxic areas. However, in general, the material contains a good amount of minerals like N, P, K, Ca, Mg, S and C which are useful for the growth of the plants and to maintain biodiversity and clean environment. Therefore, the simplest method of preparing MROM from this waste material is just to crush it into a powder form in dry condition and test its constituents. Additional quantity of minerals or even some additional minerals like Fe, Cu etc can also be added at this stage, if required. The final product is tested in the laboratory to check whether it meets the requirements of the MROM and packed as per the laid down norms for packaging. The Process Flow Diagram is given at Figure 1 below.



Figure 1 : Simplified Process of Manufacturing MROM-1 From Waste of Saturated Filters of BUNKERMAN's CO2/TVOC and Pollution Removal System

B. Embodiment 2

<u>MROM-2</u>. The preparation of MROM-2 involves simple biological and physical methods as indicated in Figure 2. In this method, the biodegradable agricultural waste, Cow Dung, Gomutra (Cow Urine), the waste obtained from saturated filters of Bunkerman CO2/TVOC Removal Systems and other important minerals like Rock Phosphate, Zeolite, Bentonite, Gypsum, Kaolin, Carbon, Silica etc, depending on the local availability, are used to manufacture MROM.



Figure 2 : Simplified Process of Manufacturing MROM-2 From Waste of Saturated Filters and Biodegradable Agricultural Wastes



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The detailed stepwise procedure is listed below:-

- 1) Cut open the Filter cover and collect the waste (absorbents/adsorbents/molecular sieves and other ingredients) from the filter into an open tray.
- 2) Grind the waste in a grinder to form a fine powder.
- 3) Carry out laboratory tests to determine its constituents.
- 4) Collect the biodegradable agricultural wastes available (such as tree leaves, sugarcane leaves, rice husk, rice plant (parali), sugarcane bagas, grass, wheat husk, animal feed waste, food waste, fruits & vegetable waste etc). Spread this waste in a composting pit or bed in 3 to 5 layers, one by one and spread a mixture of cow dung, cow urine and water on it so that complete waste material becomes property wet by this fluid mixture.
- 5) Now spread a fine layer of waste material obtained from filters as explained in steps 2 and 3 above.
- 6) Spread a thin layer of any additional minerals such as Rock Phosphate, if required.
- 7) Repeat the steps 4 to 6 above in three to five layers depending on the amount of material available and quantity of MROM required to be manufactured.
- 8) Cover the entire bed or pit with about 5 to 10 cm thick soil layer all around and leave it for natural fermentation/composting for 30 to 45 days.
- 9) After 30 to 45 days, remove the soil from a portion of the bed/pit and check whether the agricultural waste has been properly composted. If not, cover it with soil again and wait for few more days. If yes, then remove the top soil layer from the bed/pit and cut and mix the composted material with a spade or any other tool to obtain a nearly uniform material.
- Add any additional minerals or nutrients, if required and carry out the final quality check in the laboratory for the prepared MROM.
- 11) Your MROM-2 is now ready for packaging, sale and use in organic farming.

C. Embodiment 3

<u>MROM-3</u>. In this method, first the vermi compost is prepared from the agricultural waste by using cow dung and the earth worms. Then the waste obtained from BUNKERMAN filters is processed and mixed with this Vermi compost in appropriate proportion in a mixing bed. Additional minerals/nutrients are then added to it, if required. The prepared MROM is then tested in the laboratory for quality check and then sent for packaging and further use in organic farms. The manufacturing process is illustrated in Figure 3 below.



Figure 3 : Manufacturing Process of MROM-3 From Waste of Saturated Filters and Vermi Compost



D. Embodiment 4

Experiments conducted on Earthworms have shown that the earthworms grow better and faster on mineral rich diet. Earthworms need a continuous supply of calcium. South Australian research found that earthworm numbers doubled when pH(CaCl₂) in their feed/soil rose from 4.1 to 6.7. Experiments were conducted by adding the waste of BUNKERMAN's saturated filters to the feeding material supplied to the earth worms and it was found that the size and number of earthworms was considerably increased in this process. The resulting vermi compost was also found to be rich in mineral contents. Therefore, the fourth type of MROM i.e. MROM-4 was prepared as per the process illustrated in Figure 4 below.



Figure 4 : Manufacturing Process of MROM-4 From Waste of Saturated Filters and Agricultural Wastes by Using Earth Worms



Photo 1 : Photo of Vermi Composting Bed Showing How Worms Convert the Waste Material into MROM-4



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Photo 2 : Composting Pits for MROM-2 During Experiments



Photo 3 : Vermi Composting Beds for Manufacturing MROM-4



Photo 4 : Final packaging of MROM-3



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III. RESULTS

A. Test Results

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मुदा स्वास्थ्य कार्ड 57-प्रयोगशाला का नाम :- कृषि विज्ञान केन्द्र हस्तिनापुर किसान का विवरण सॉयल परीक्षण परिणाम भारतेरा भन्नेनीम्हस নাম चता 210. HETU (ALTO) चाप पैरामीटर परिणाम आकलन क्रमांक इकाई तासील 251 दिवन おいろ जणीय <6.5 सायान 6.5-7.5 हारीय >7.5 7.55 पी.एच. (pH) विनयरेव 1 আমাৰ মাতনা 0.27 ई.सी. (EC) 2 দাবাইন নাত্য 1.0 से कम 84 < 0.20 0.21-0.40 0.41-0.60 0.61-0.00 बात । सन्दर्भ सम्पर्भ मृदा नमूना विवरण 3 जैविक कार्वन (OC) 135 L मृदा नमूना सर 490 পমুৰা হজত কৰণ কী হিটি 17/3/2022 or 4 उपलब्ध नाइट्रोजन (N) তন কর্ম রাজ্য < 250 250-500 >500 207.6 194.34 सई संस्था बहुत क्षेत्र संदर्भ जावन 5 ন্তন্তৰ নাৰৰ उपलब्ध फास्फोरस (P) 0-10 13-30 21-30 31-40 24.9 y th खेत का क्षेत्रफल 6 उपलब्ध पोटैशियम (K) भू-रियाटि (GPS) 10-50 51-100 301-180 181-250 अतांस . जन्मित देशान्तर 120 M মিমির / অধিমির মৃমি १३ वे कर १९ वे कर १९ वे १६ १९ वे जीवन मेलेहरू ०.६ मे दन्द 7 उपलब्ध सल्फर (S) संदर्भ उपज के लिए उर्वस्क सिफारिशें (जैविक खाद के साथ) 4.9 एन.पी.के. सिष्ट् उर्वरक संयोजन-2 (1222 M) 8 उपलब्ध जिंक (Zn) हम् ०.६ में हम् मज़ब् ०.६१–१२ उपम १३ में अप्रिय कर्माएम লে ব জি उर्यरह एन.पी.जे. निए उर्वरह संबं 2.0 ٩Ę युरिवा 225 युरिया 237 कम् ३.२५ में दम् महम् ३.२५-०.५ अभ्यः ३.३५-०.५ प्रमारः ३.४ अधिरः 9 उपलब्ध बोरॉन (B) .48 68 79.8.8.140 the state कटाला ३० 100 4 से हम 4.1 में 80 8 से जग्रिक जिन्दम्म 10 419 4/20 उपलब्ध ऑयरन (Fe) 1.9 the set मूरिया -295 बुरिब ५ उप्ट 0.21 से कम 0.21 से 04 04 में करिस वेपील्म 40 चंदारा J 21. (K.B.F7 11 रूष मध्यम् अप्रम उपलब्ध मैगनीज (Mn) .57 रीएपी 110 पोटाश 25 ठन कृतर उपल 152 0.2 12 शे हुद से उड़ीय उपलब्ध कॉपर (Cu)

 Table 1 : Soil Health Card & Soil Test Results : Sample 1 (Soil Only)

Table 2 : Soil Health Card & Soil Test Results : Sample 2 (Soil + 10% Vermi Compost)

		ត្រ	रेसान का विवरण					3			
AN HOTEL SUTTING					सॉयल परीक्षण परिणाम						
पत	पता >1071										
яг	4	Host	T (GETTT)		annine.	रीजसीटन	प्रजिलाम	रकार्ट	3110300		
বহ	चील	मयान	T		90H142	441-110-1		24/12	onque		
তি	ला	नेरु						जण्तेग < 6.5			
থি	গৰ্কার				1	पी.एच. (pH)	7.65	समाच 6.5-7.5			
ઞ	पार संख्या					(0		env yra			
मो	बईत संख्या				2	इ.सी. (EC)	0.35	1.0 से कम			
मुदा नमूना विवरण			3	जैविक कार्बन (OC)	.59	¥हरा अम्म < 0.33 अन्म 0.33-6.40 भारम 0.43-6.60 अम्मम 0.65-6.80	M				
भाग प्रथम स्वर्थ की लिखि 17/3/2023			4	उपलब्ध नाइट्रोजन (N)	272.24	1814 × 250 1903(1) 250-500 34444 × 500					
खन खेर	तरा मम्बर त का होत्रफल				5	उपलब्ध फास्फोरस (P)	22.4	भट्टा अभ 0-10 भग 13-30 भग्रम 23-30 भग्रम 31.40	м		
মু–মিক্রমি (GPS) এজাগে বিশান্তর মিটিার / এরিহির সুদি <i>– শির্টানিয়া ।</i>		6	उपलब्ध पोटैशियम (K)	175	श ट्रा सम 5-50 सम 51-100 शहरूम 203-180 शास्त्र 182-350	М					
dan	र्भ उपज के	लिए उब	र्बरक सिफारिशें (जे	विक खाद के साथ)	7	उपलब्ध सल्फर (S)	15:9	कामा स्टब्स् स्वया स्टबी का जन्मा स्टबी करिक			
ti¥	फनाल व किल्म मेह	उर्ररक युरिया	एन.पी.वे. लिए वर्षस्त्र संघोधला- । राष्ट्र	। इन.प्रे.सं. सिए उर्ववत्त यांवोजन-2 (२३२अ) मरिमा 167	8	उपलब्ध जिंक (Zn)	10.9	कम् ०.६ चे छन् स्टब्स् ०.६१-१२ अपस १२ से अधिक विदिया			
		र्चटाण	60 49129	140 Hanna 2	9	उपलब्ध बोरॉन (B)	. 58	क्ष्म 0.35 से क्षम सरम्म 0.29-0.5 अभग 0.5 में क्रिक दिर्दा			
	And	गुरिया गुरिया	308 41 /2	यहिंसा 330 म्यू ()यू	10	उपलब्ध ऑयरन (Fe)	2.4	क्रम 4 से रूप कृत्यम् 4.5 से इ.इ अफ्रम् ह से अधिक इत्यम् इत्यम्			
		चटारा ठीरपी	110	पोग्रे. 156 पोलग २५	11	उपलब्ध मैगनीज (Mn)	. 62	कम 021 वे कम मध्यम् 021 वे 04 जन्मर: 04 में अनेक संग्रेंद्रम			
-					12	उपलब्ध कॉपर (Cu)	.59	क्या 82 से स्टन सम्मन 825 जे 84			

Table 3 : Soil Health Card & Soil Test Results : Sample 3 (Soil+10% MROM-1)



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(ISALIS)	a	મૃલ	। स्वास्थ्य क	ਗਤੀ		प्रयोगशाला का नाम :- कृषि विज्ञान केन्द्र हस्तिनापुर							
	किसान का विवरण												
শাম	শান্দ সত্রীবৃদ উপনি পি কর্ম				सॉयल परीक्षण परिणाम								
पता	पता भुठेप्रेरि												
प्राम	রাম পর্যাত (এর্ফুন্ড)				क्रमांक	पैरामीटर	परिणाम	इकाई	आकलन				
राहत	सहसाल भूप्रान्ग												
থিন	भ बरेड	-7 [3				1	पी.एच. (pH)	7.60	अप्रीत <6.5 मध्यत्व 6.5-7.5				
आप मोबा	गर संख्या ाईत संख्या					2	ई.सी. (EC)	1.0	1.0 से रुम				
मदा	मृदा नमूना विदरण			-	3	जैविक कार्बन (OC)	- 40	बहुत सम् <0.30 354 0.21-0.40 मध्यम् 0.43-0.50 त्राजम् 0.63-0.80	L				
जमून सर्व र	प्राप्त प्रकार करने की तिथि 17/3/2013		-	4	उपलब्ध नाइट्रोजन (N)	220-12	क्षम् <250 मध्यम् 258-500 अगव्य ×560						
खरार चेव	यत्य प्रथम स्वत्य गवर स्वेत का संवयन			-	5	उपलब्ध फास्फोरस (P)	1:B •8	सहूत कम 0-13 हमें 11-20 महनम् 25-90 महनम् 31-40	L				
मू-रि शिषिः	ষ্মিরি (GPS) ন / असिंथित শুশি	-	सांश निर्दान्द्रि	देशान्तर		6	उपलब्ध पोटैशियम (K)	/60	महुत सन् 0.50 सन् 51-180 महम्म 200-280 अप्रस 200-280	М			
संदर्भ	f उपज के f	लिए उ	र्वरक सिफारिशें (जं	विक खाद के साथ)	1	7	उपलब्ध सल्फर (S)	11.7	बन्न १० में बन् सन्दर्भ ११ में १५ अथन १८ में अग्रेज				
क्रमांक	कत्तत व किस्म जेहें	उर्तरह रचिन	एन.पी.के. लिए जर्दरक संबोजन		1000	8	उपलब्ध जिंक (Zn)	6.8	कर 0.5 से सन काइम 0.61-12 आसम 12 के अधिक केफ्रिम	÷			
1.		भोटा श मोटा श	68	भूष्या 2/3 एन.पी.के. 192		9	उपलब्ध बोरॉन (B)	.32	कर 0.25 वे कर कृत्रम् 0.26-65 अवम् 0.5 में अप्रिक वीर्वीहरू				
2.	तन्ना	ढाएपा सूरिया	382 4/Kg	पोताश 15 402n यूरिया 387		10	उपलब्ध ऑयरन (Fe)	3.2	क्षम क से कम कत्रम का से का अथग क से कडिक पैमीएम				
		पोटाश ढीएपी	68	एम.फ्रे. २०३ प्रेटास / 3	1	11	उपलब्ध मैगनीज (Mn)	. 61	कष 0.21 ही कम सम्बन्ध 0.21 ही 0.4 जन्मता 0.4 ले जरिक बीमीटन				
						12	उपलब्ध कॉपर (Cu)	. 25	हम् ६२ से छन् सम्पन् ६२१ से ६४ जन्मा ६४ से अधिक संग्रीपूर्व				

Table 4 : Test Results of Vermi Compost : Sample 1





Table 5 : Test Results of Vermi Compost Plus Waste of BUNKERMAN Filter Material (MROM-1) : Sample 2

NĘ	ON	NEON IND	USTRI Mobile : 82	AL TES A Laboratory : 20 18221131, 844	TING & RESEARC n ISO 9001 : 2015, ISO 14001 : 20 IS A-B., Rajpura, Mawana Road Ne IS233689, Website www.neonitri.co	H LABORA 115, ISO 45001 : 20 ar Subhash Inter Co om,E-mail : neonitri		
			TES	T REPO	ORT			
		VERMI	COMP	OST AN	ALYSIS REPORT			
	REPOR	TNO. VC/NIT	RL/50720	230321-02	PAGE	1 of 1		
	SAMPLE CODE: Ve			/507	SERVICE REQUEST DATE	5 21.03.2023		
	REPORT ISSUE DATE			REF. NO NITRL/MSP-21/TR-W/FMT-7.8 SAMPLE F				
	M/S - Bunkerman Plot No. 20 Himuda, Batolikalan, Bat Industrial Area, Solan, Himachal			Description : One Vermicompost Sample receive				
				Sample M	Sample Marking : Vernicompost S			
	Pradesh,	173205		Analysis D	Analysis Done on : 21.03.2023 to 23.03.2023			
			TES	ST RESULT	r			
	S.No.	Parameter	Result	Unit	Test Method			
	1.	pH 10 % Sol.	9.32		NEON/VC/SOP/	006		
	2.	Moisture	56.22	96	NEON/VC/SOP/	08		
	3. Organic Matter &		1.76	96	NEON/VC/SOP/	010		
	4. TKN		0.095	96	NEON/VC/SOP/	012		
	5.	Sulphur	480	Mg/kg	NEON/VC/SOP/	013		
	6. Calcium		0.51	%	NEON/VC/SOP/014			
	7.	Phosphorous	0.046	%	NEON/VC/SOP/016 NEON/VC/SOP/018			
	8.	Potassium	0.16	%				
	9, Magnesium 10. Iron 11. Zinc		0.023	%	NEON/VC/SOP/015			
			66,4	Mg/kg	NEON/VC/SOP/	026		
			480	Mg/kg	NEON/VC/SOP/	027		
	12.	Copper	248	Mg/kg	NEON/VC/SOP/	032		
	L	1	-1	ad of Report"				
	Constant of the second	Tr d By			The second secon	and the second second		
Note:	:-1. Bareple wil	li be retained for two weeks from t	he date of iss	use of test repor	rt, unless specified by the customer.			
	2. The results	given above are related to the ter	ited sample a	and mentioned	parameters. Endorsement of Product i	is neither inferred nor		
	9. 10131 113 649	the data would be takinged to panelic	ee Artiount.		and all the lat			
	4. This report	t ean net used as evidence in a co	UT OF IOM WE	nout the written	approval of the lab.			
	4. This report 5. Constituate	t can not used as evidence in a co shall not be reproduced expect in	full, without	the written app	roval of the laboratory.			

IV. DISCUSSION

The test results conducted on soils (Table 1 to 3) indicate that the mineral contents of the soil get improved by addition of Vermi Compost and MROM-1. The test results shown in Tables 4 and 5 indicate that the mineral contents of Vermi Compost get significantly enhanced by addition of MROM-1 to the Vermi Compost. This mixture of Vermi Compost and MROM-1, in fact, forms MROM-3 discussed above. The tests results of MROM-2 and MROM-4 also showed a significant amount of mineral content in the manure which are useful for the plant growth.



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V. CONCLUSIONS

The "Minerals Rich Organic Manure (MROM)" is manufactured from the biodegradable agricultural waste, Cow Dung, Gomutra (Cow Urine), the waste obtained from saturated filters of Bunkerman CO2/TVOC Removal Systems and other important minerals like Rock Phosphate, Zeolite, Bentonite, Gypsum, Kaolin, Carbon, Silica etc, available in nature. The emphasis has been on the significance of sustaining agricultural productivity and microbial diversity in the rhizosphere In this manner, the nitrogen, phosphorus, potassium and total nutrient of the soil, improve greatly with use of MROM in farming. Four types of "Minerals Rich Organic Manures (MROM-1 to MROM-4)" have been manufactured by making use of the waste obtained from saturated filters of Bunkerman CO2/TVOC Removal Systems, the biodegradable agricultural waste, Cow Dung, Gomutra (Cow Urine) and other important minerals like Rock Phosphate, Zeolite, Bentonite, Gypsum, Kaolin, Carbon, Silica etc, available in nature.

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