IIT KHARAGPUR

NPTEL ONLINE CERTIFICATION COURSES

Organic Farming for Sustainable Agricultural Production

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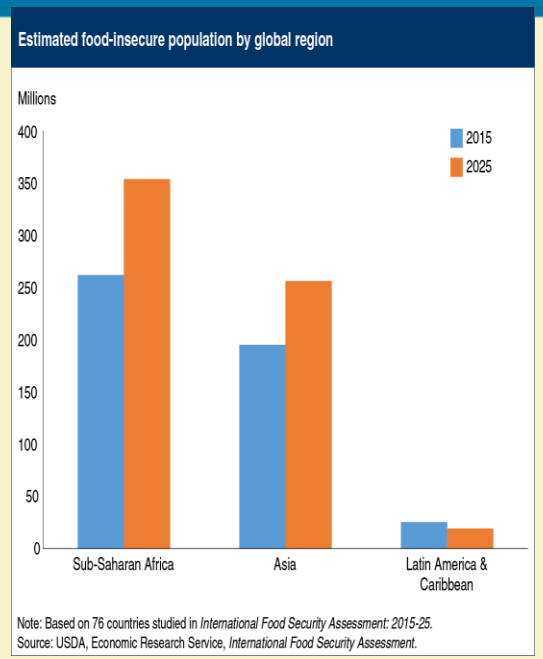
Lecture 15: Enriched Vermicompost Production Technology



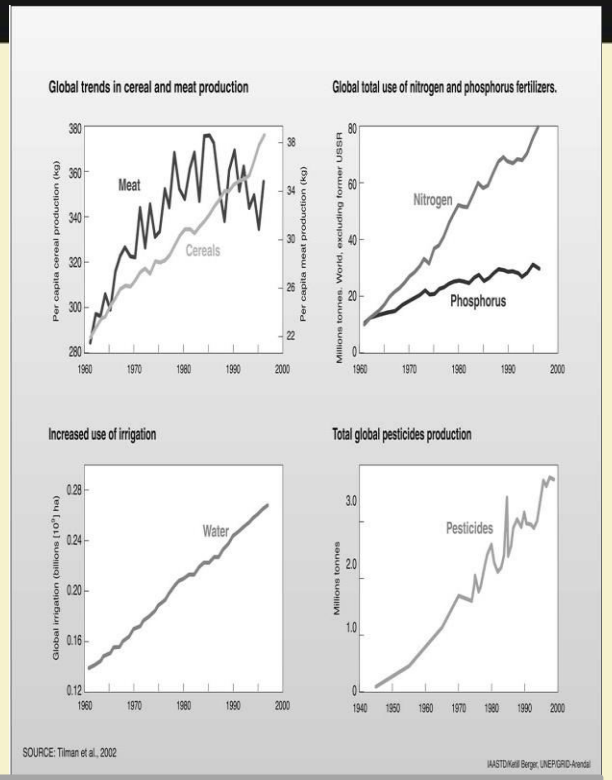
More Food required In 21st Century

Chemical farming is an easy option

Many disadvantages

Organic farming is better option

Needs value addition of Vermicompost for improved yield



Advantages of organic farming

- Improved soil health and quality
- Disease and pest resistance to plants
- Recycling of agricultural and aquatic wastes with lower input costs

Disadvantages of chemical farming

- Soil erosion and salinity
- Frequent use of fertilizer and increased cost of production
- Environmental pollution and increase in global warming

Why Enriched Vermicompost (VC)?

- In general, the organic manures like FYM, compost , vermicompost contain on an **average 0.5 to 1.5% N, 0.2 to 0.8% P_2O_5 and 0.5 to 1.2% K_2O,** Which **is not sufficient to meet the crop demand in low dose.**
- For supplying N at 100 kg ha^{-1}, the organic manure to be applied at **07 to 20 t ha^{-1}.**
- These demerits of manures can be overcome to a certain extent through preparation of enriched VC by adding natural or biological sources of **nitrogen, phosphorus, potassium and micronutrients** either alone or in combination.
- Moreover waste with different nutrient rich substances opening **new direction of technological up gradation** for improving the quality and nutrient status of vermicompost.
- **Modification of vermicompost** is done either by microbial enrichment or fortifying with **nutrient rich rock minerals and agricultural waste** .

Nutrients enrichment strategies from natural resources

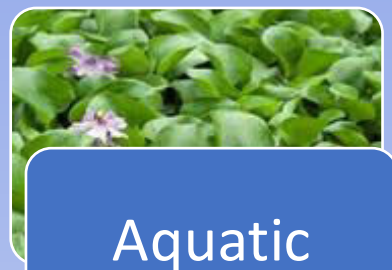
Nutrient Enrichment	Natural resources
Nitrogen	Common oil Cake like Mustard cake (5.3%), Groundnut cake (7.3%), Neem cake (5.2%), Karanja cake (3.9%), Sesame cake (6.2%), Castor cake (4.3%) etc.
	Poultry manure, Azolla, Green manure crops or wastes forms leguminous crops
Phosphorus	Rock phosphate (20-40%) Bone meal (20-25%) Basic slag (17-20%) Horn and hoof meal Wastes from fish and animal processing
Potassium	Sylvite (63.1) Wood ash [Eucalyptus wood (5.9)] Casuarina wood (1.5%) Tobacco stem (2.6%) Babool wood (2.5-3.0%)
Calcium and Magnesium	Limestone, Gypsum and Dolomite

Enrichment of vermicompost can be done in two ways

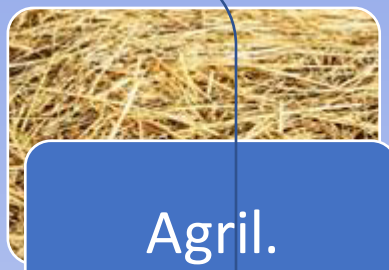
- Addition of rock minerals during composting process
- Addition of rock minerals with ready compost

Preparation of Enriched Vermicompost (VC)

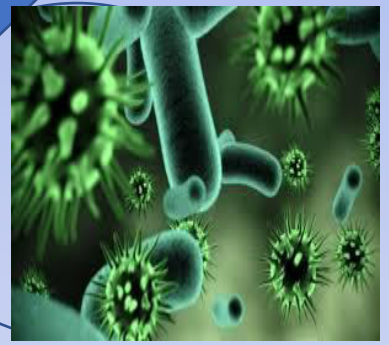
Cow Dung



Aquatic Weeds

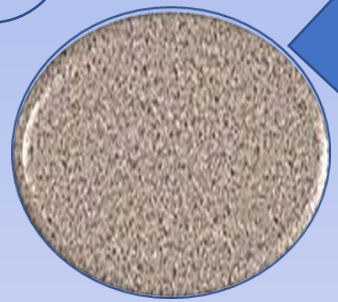


Agril. Wastes



Microbes

@50ml broth per kg of Organic wastes



Rock phosphate, Dolomite, Mica

(P enrichment) (Ca and Mg) K enrichment

Nutrient content	Rock phosphate	Dolomite	Mica
pH	8.14	7.24	7.12
Total N (%)	nd	nd	nd
Total P (%)	**8.52**	0.01	0.01
Total K (%)	0.30	nd	**10.12**
Total Ca (%)	8.12	**19.25**	0.08
Total Mg (%)	4.82	**12.84**	6.32
Available N (ppm)	nd	nd	nd
Available P (ppm)	**35.20**	nd	nd
Available K (ppm)	55.60	nd	**140.00**

Preparation of Enriched VC using microbes

- *Trichoderma viridae* (Cellulolytic)
- *Azotobacter chroococcum* (N_2fixing bacteria)
- *Bacillus polymixa* (Phosphorus solubilizing bacteria)
- *Bacillus firmus* (Potassium releasing bacteria)
- Mix of above

Effect of different organic wastes and microbial inoculants on organic carbon and nitrogen content of vermicompost

Microbes (M)	Organic carbon (mg g^{-1})				Nitrogen (mg g^{-1})			
	Wastes (W)			Mean	Wastes (W)			Mean
	WH	PS	SD		WH	PS	SD	
CL	282	383	556	**406**	14.0	13.1	2.8	**10.0**
TV	222	300	503	**342**	18.5	16.1	3.5	**12.7**
AZC	255	338	533	**376**	23.0	20.2	4.1	**15.8**
PSB	262	362	542	**389**	19.3	17.2	3.1	**13.2**
KSB	266	367	546	**393**	17.5	16.0	2.9	**12.1**
MIX	174	285	480	**313**	24.2	22.5	4.4	**17.0**
Mean	**243**	**339**	**527**		**19.4**	**17.5**	**3.5**	
	W	M	W x M		W	M	W x M	
SEm	3.4	4.8	8.2		0.2	0.3	0.5	
LSD(P>0.05)	9.7	13.7	ns		0.6	0.8	1.3	

58%

70%

Microbial inoculation:

- *CL: No microbial inoculation*
- *Trichoderma viridae* (TV)
- *Azotobacter chroococcum* (AZC)
- *Bacillus polymixa* (PSB)
- *Bacillus firmus* (KSB)
- Mix: TV+AZC+PSB+KSB

Organic waste:

WH: Water Hyacinth
PS: Paddy Straw
SD: Saw Dust

Effect of different organic wastes and microbial inoculants on Phosphorus and Potassium content of vermicompost

Microbes (M)	Phosphorus (mg g^{-1})				Potassium (mg g^{-1})			
	Wastes (W)			Mean	Wastes (W)			Mean
	WH	PS	SD		WH	PS	SD	
CL	7.2	7.7	1.0	**5.3**	9.7	9.1	1.7	**6.8**
TV	8.3	8.3	1.7	**6.1**	10.7	9.6	2.1	**7.5**
AZC	6.9	7.9	1.0	**5.3**	9.7	9.7	1.4	**6.9**
PSB	8.8	9.5	1.3	**6.5**	9.6	9.9	2.0	**7.2**
KSB	7.2	7.8	1.2	**5.4**	12.8	12.2	2.6	**9.2**
MIX	9.6	10	2.7	**7.5**	14.4	13.2	3.7	**10.4**
Mean	**8.0**	**8.6**	**1.5**		**11.2**	**10.6**	**2.2**	

43%

45%

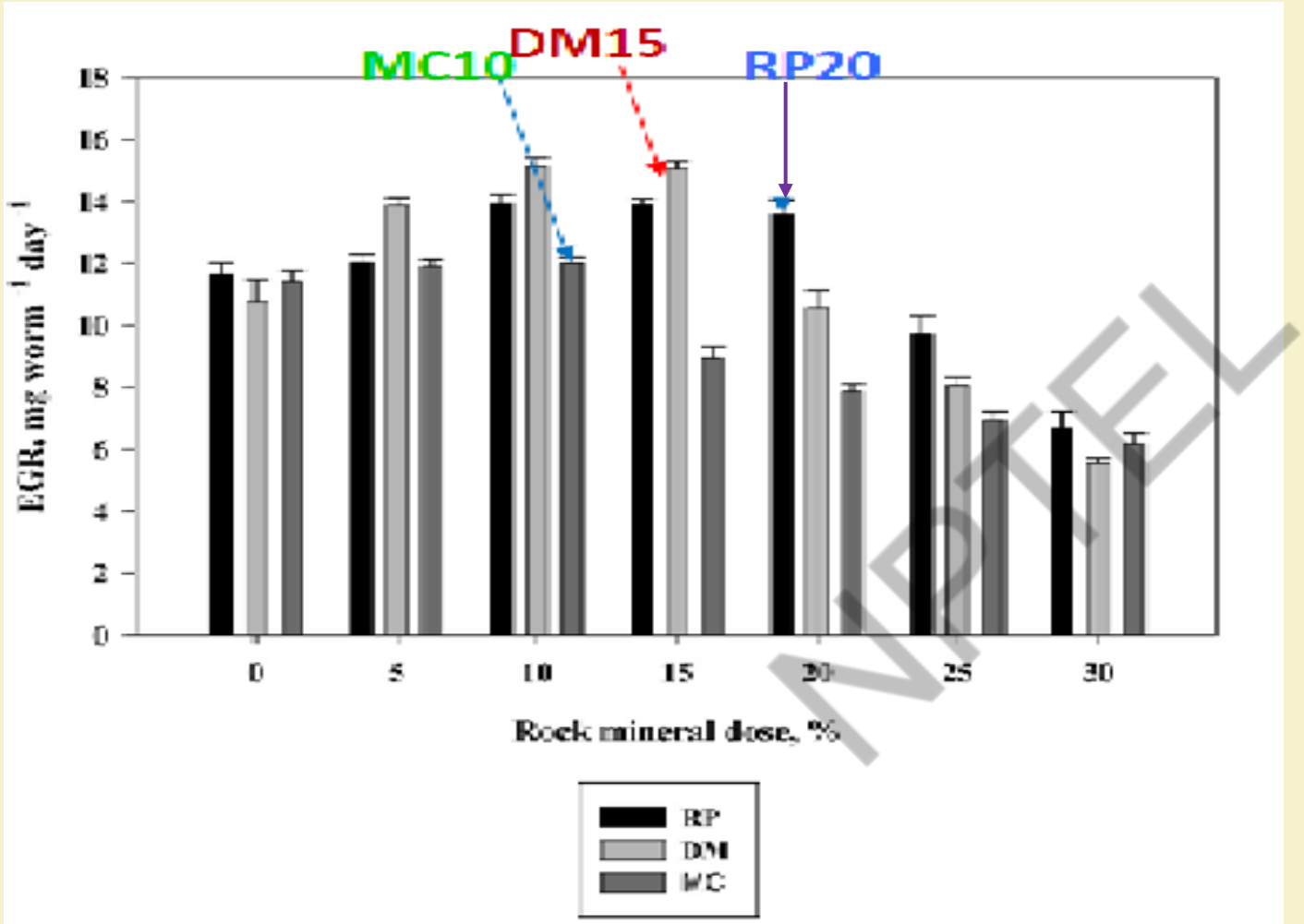
Microbial inoculation:

- *CL: No microbial inoculation*
- *Trichoderma viridae* (TV)
- *Azotobacter chroococcum* (AZC)
- *Bacillus polymixa* (PSB)
- *Bacillus firmus* (KSB)
- Mix: TV+AZC+PSB+KSB

Organic waste:

WH: Water Hyacinth
PS: Paddy Straw
SD: Saw Dust

Effect of Rock Mineral doses and microbial inoculation on Earthworm growth rate (EGR) in vermicompost



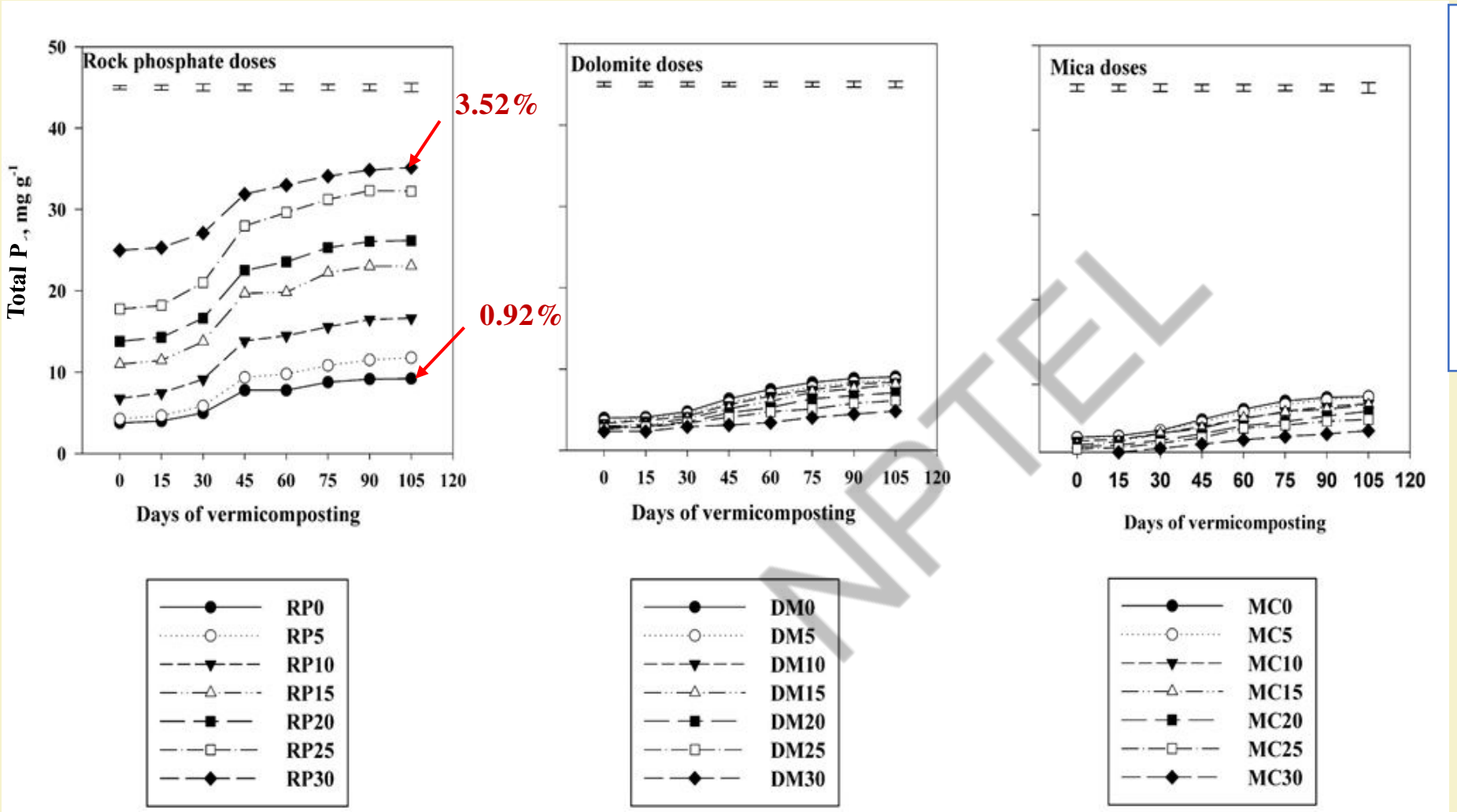
Rock minerals

Rock phosphate (RP)

Dolomite (DM)

Mica (MC)

Effect of rock mineral doses on Total P content of vermicompost during composting process



Rock minerals

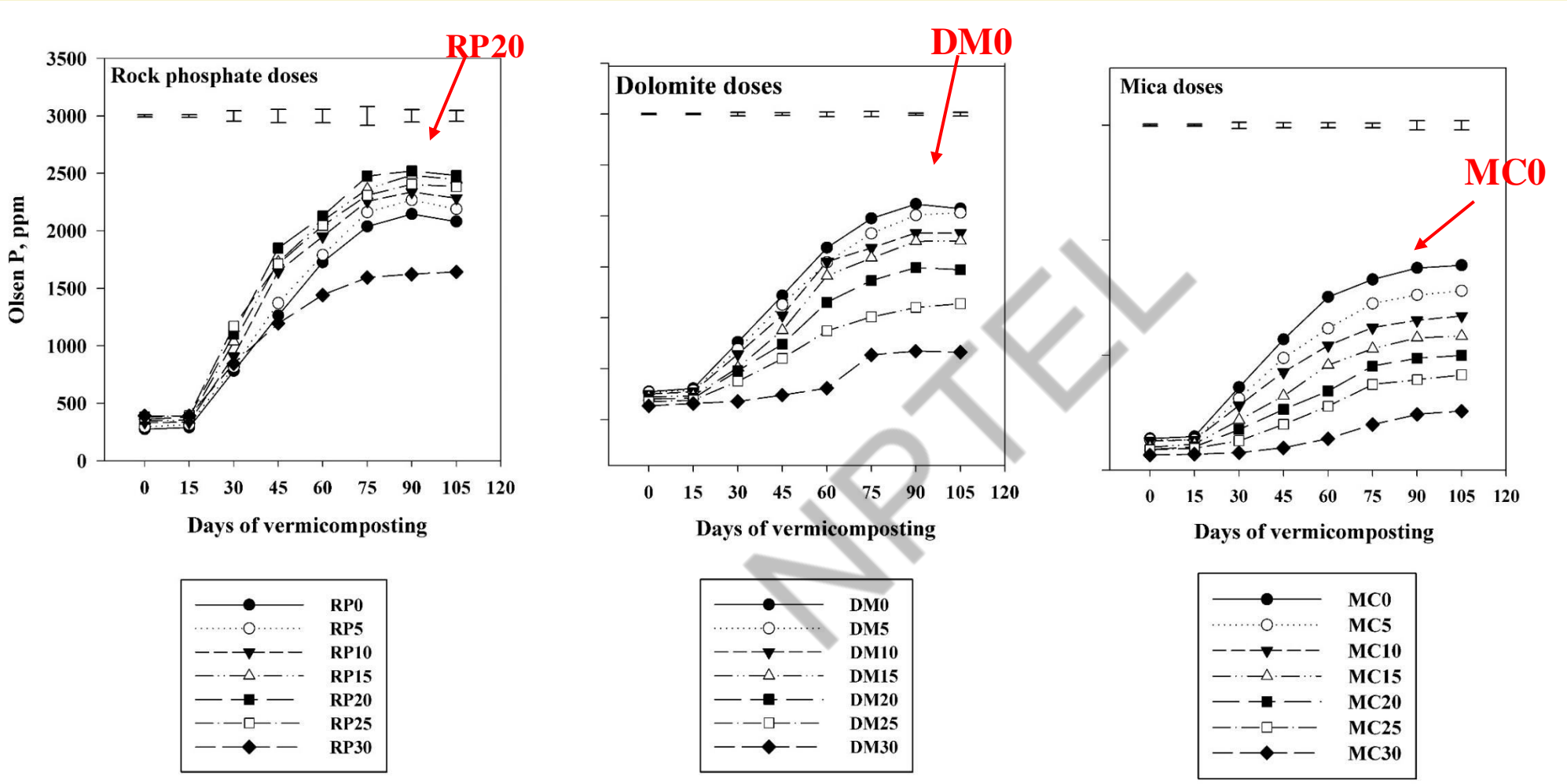
Rock phosphate (RP)

Dolomite (DM)

Mica (MC)

The rock minerals were applied at 0 to 30% of organic wastes

Effect of rock mineral doses on Olsen P content of vermicompost during composting process



Rock minerals

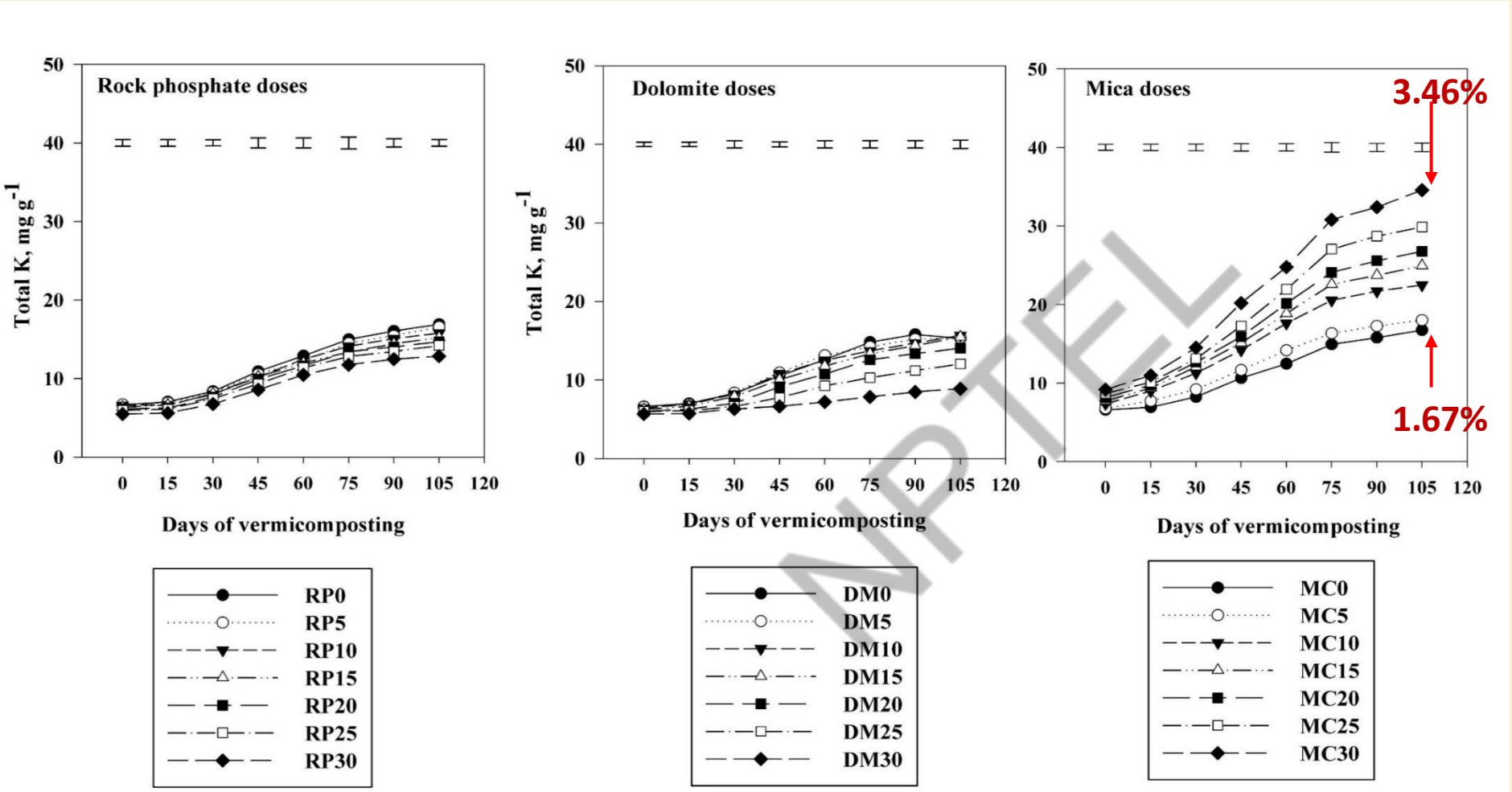
Rock phosphate (RP)

Dolomite (DM)

Mica (MC)

The rock minerals were applied at 0 to 30% of organic wastes

Effect of rock mineral doses on Total K content of vermicompost during composting process



Rock minerals

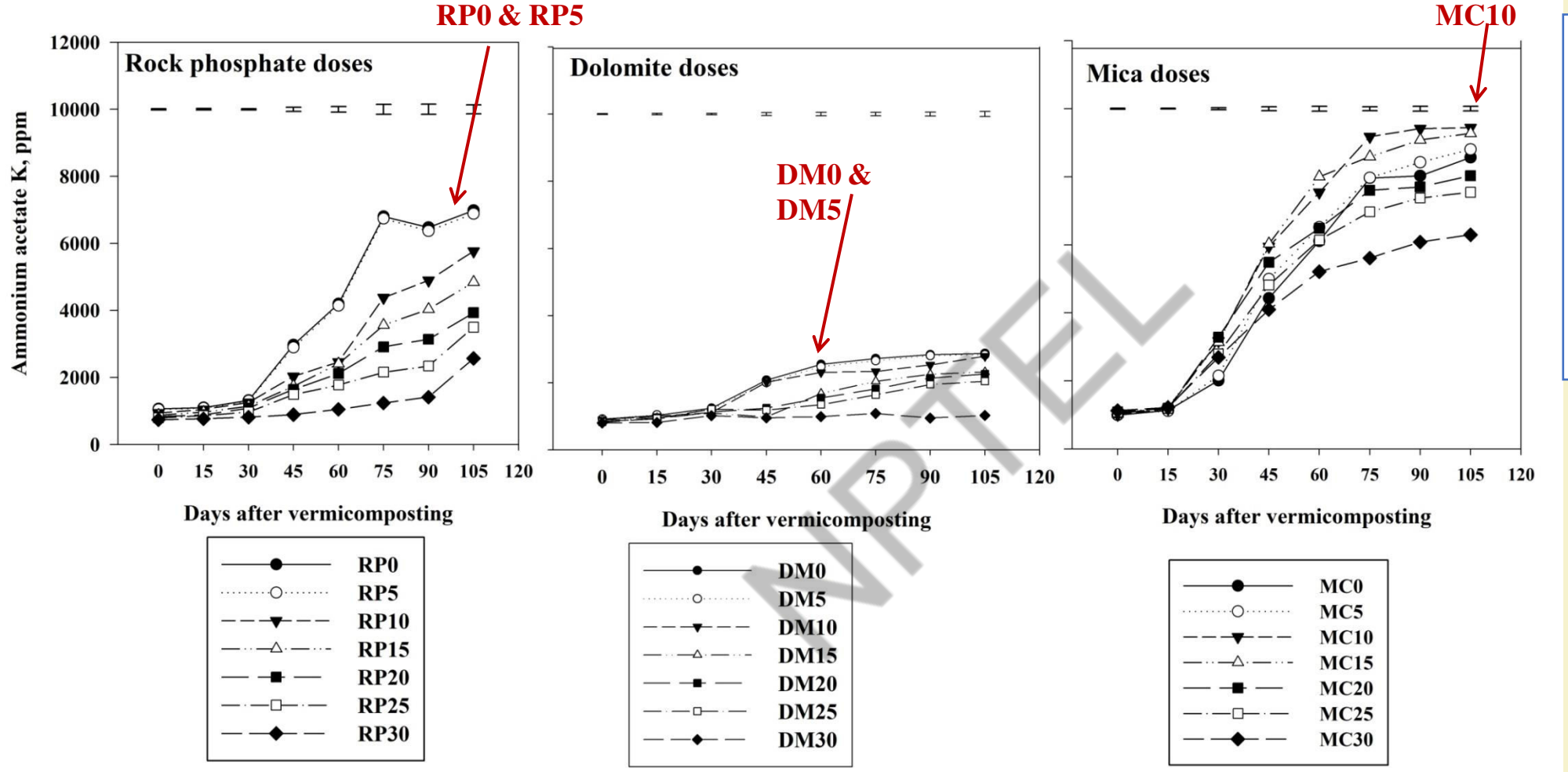
Rock phosphate (RP)

Dolomite (DM)

Mica (MC)

The rock minerals were applied at 0 to 30% of organic wastes

Effect of rock mineral doses on Ammonium acetate K content of vermicompost during composting process



Rock minerals

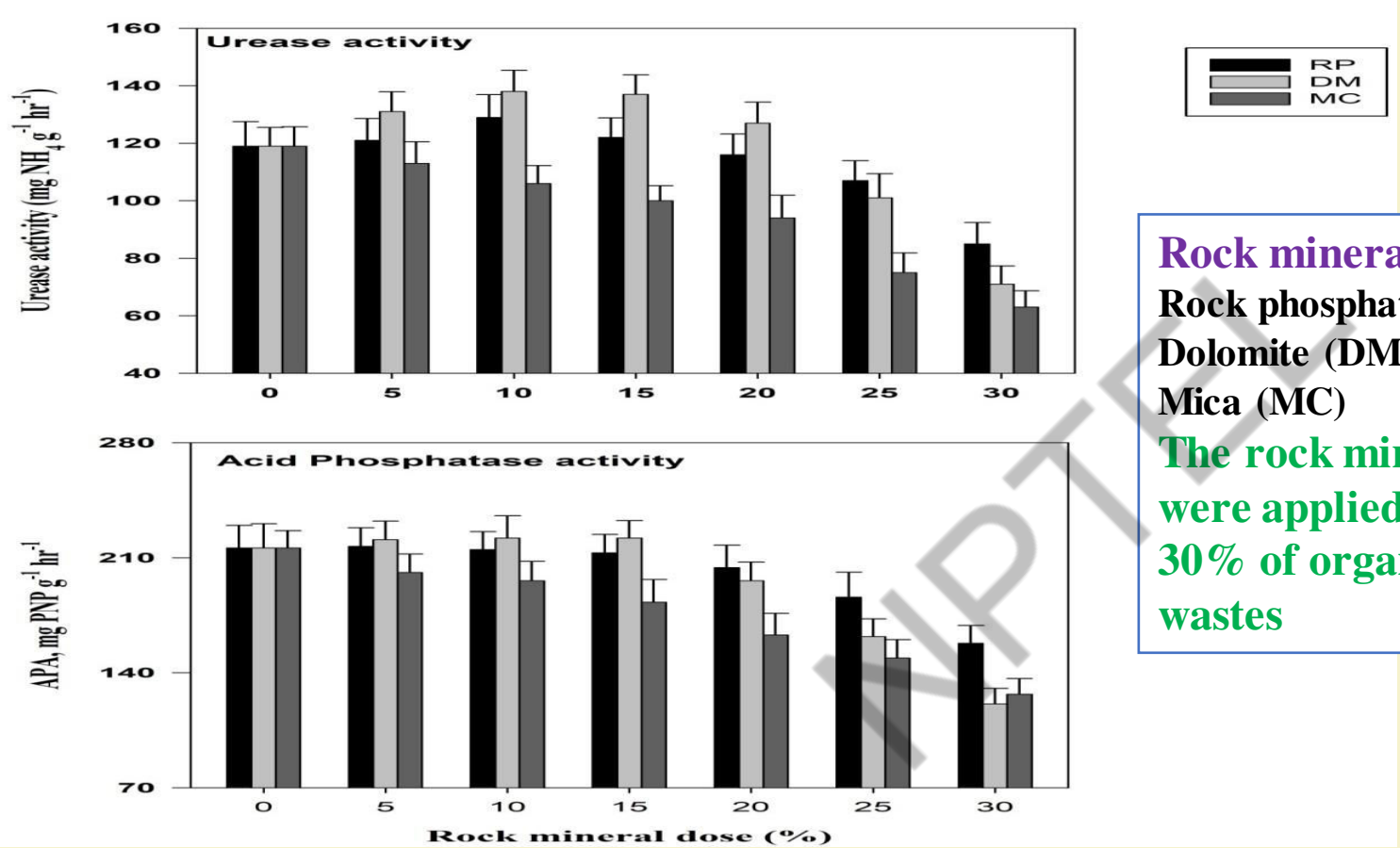
Rock phosphate (RP)

Dolomite (DM)

Mica (MC)

The rock minerals were applied at 0 to 30% of organic wastes

Effect of rock mineral doses on Bio-chemical properties of vermicompost



Rock minerals

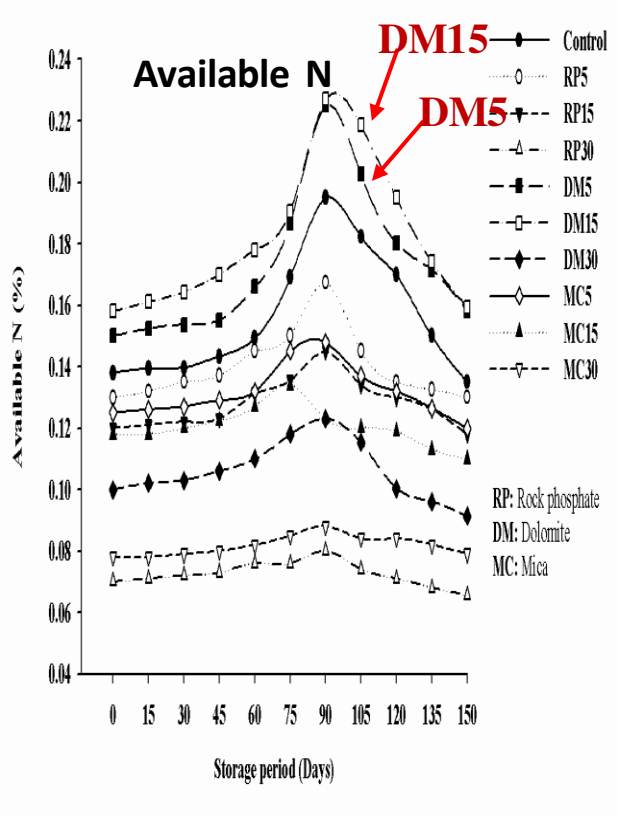
Rock phosphate (RP)

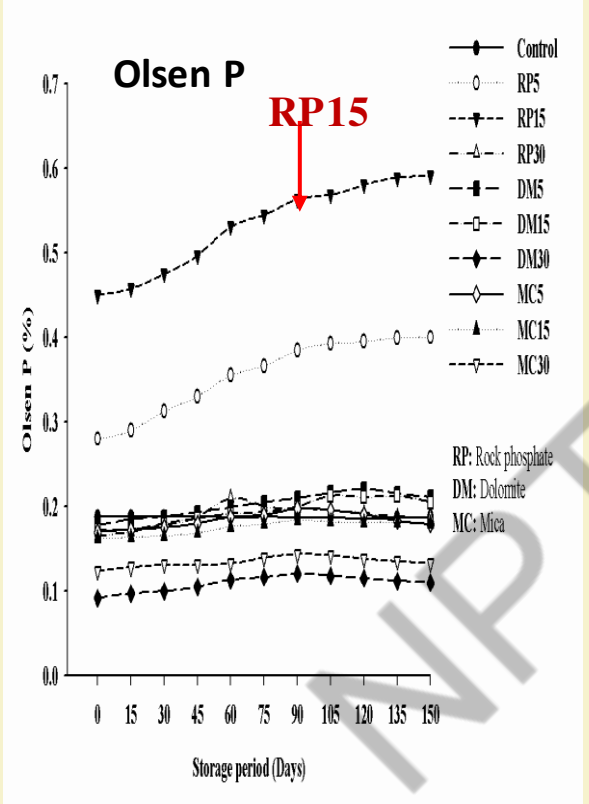
Dolomite (DM)

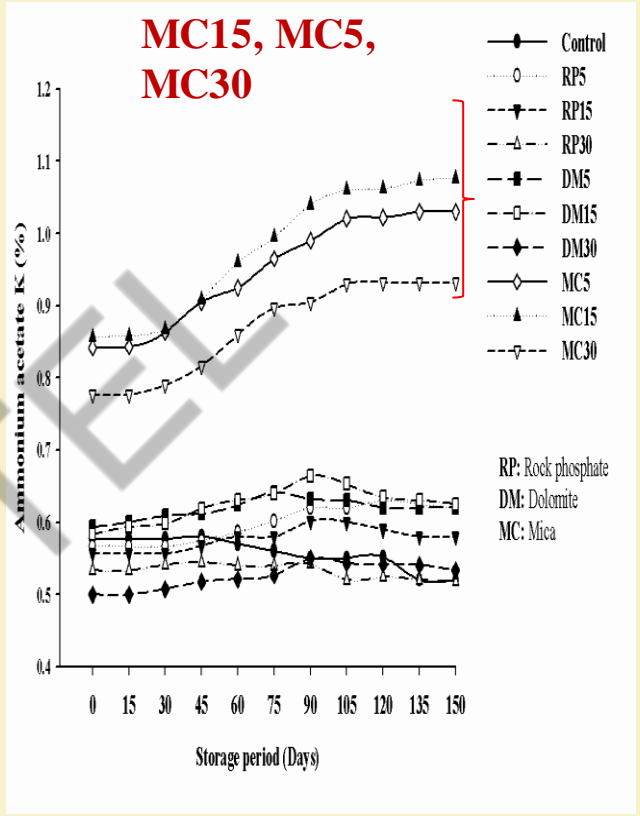
Mica (MC)

The rock minerals were applied at 0 to 30% of organic wastes

Changes in available N, P and K content of Vermicompost during storage







Rock minerals

Rock phosphate (RP)

Dolomite (DM)

Mica (MC)

The rock minerals were applied at 0 to 30% of organic wastes

Take home message

- The waste resources **Water Hyacinth and Paddy Straw having low C/N** ratio (48:1 and 67:1), **enhanced the growth rate** and population of earthworm, thereby resulted **better quality of VC** with respect to chemical and bio-chemical properties as compared to the waste resource **Saw Dust** (C/N=366:1)
- **Combined application** of **microbial inoculants** i.e *Trichoderma Viridae* , *Azotobacter chroococcum*, *Bacillus polymyxa* and *Bacillus firmus* **into organic wastes** in the vermicomposting process, **improved the chemical and bio-chemical properties** of VC significantly as compared to **convention VC** (no microbial inoculants)
- In the vermicomposting process, use **of rock minerals** such **as RP at 20%, DM at 15%** and **MC at 10%** along **with microbial inoculants** in organic wastes **enhanced** the earthworm growth rate, hence improved the **quality of VC** with respect to **higher availability of macronutrients** (N=26%, P= 19% and K=10%) over **conventional VC** (no rock mineral and no microbial inoculants)
- Application of **rock minerals** (RP or DM or MC) at 15% along **with microbial inoculants** in the vermicomposting process **increased significantly** the **bio-chemical properties of VC** such as urease assay and acid phosphatase assay content as compared to **conventional VC**
- The **effective shelf life of VC** in storage is for a period of **90-105 days**. Storage for longer period (>105 days) reduced the microbial activity and the nutrient availability of VC.