STUDIES ON THE IMPACT OF ANTHROPOGENIC WASTES ON GROWTH AND YIELD OF MAIZE AND COWPEA, MAJOR NUTRIENTS AND PATHOGEN LOAD IN SOIL

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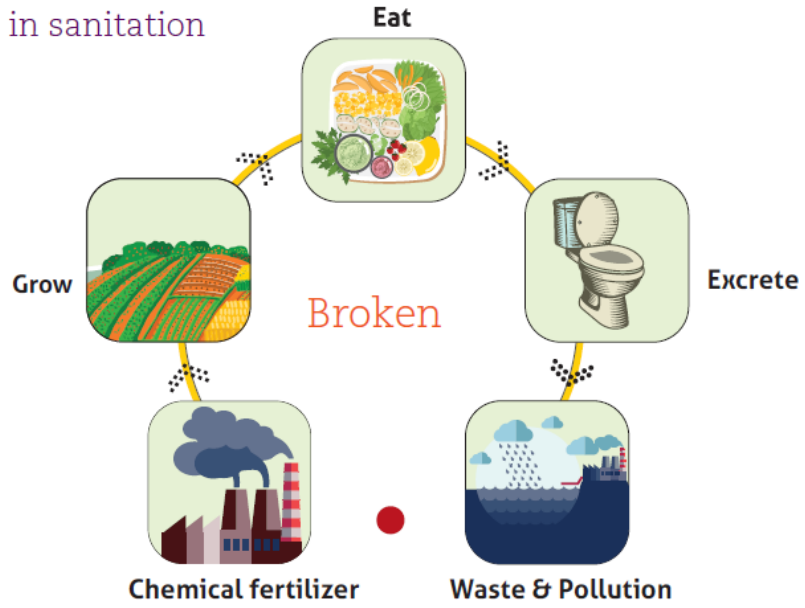
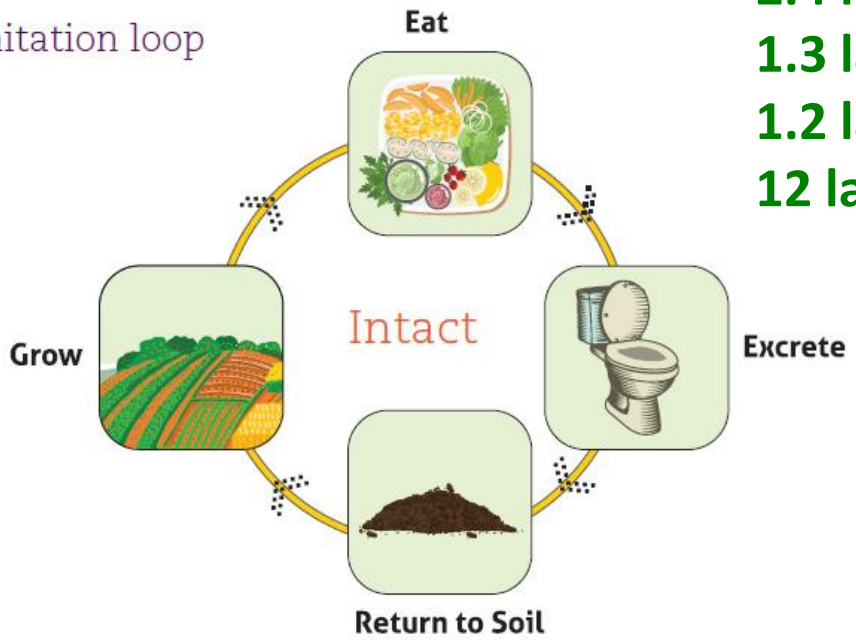
Introduction

Broken link in sanitation



17.9 million cubic meters of sewage and 4 million tonnes of sludge each year

Closing the sanitation loop



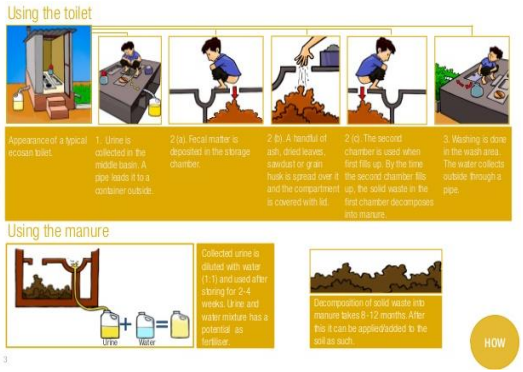
2.4 lakh tonnes of N
1.3 lakh tonnes of P_2O_5
1.2 lakh tonnes of K_2O
12 lakh tonnes of OC

Objectives

1. To characterize Humanure, Pit toilet sludge and Sewage sludge for nutrient composition and heavy metals content
2. To study the direct and residual effect of humanure, pit toilet sludge and sewage sludge application on growth and yield of maize and cowpea
3. To study the direct and residual effect of humanure, pit toilet sludge and sewage sludge application on major nutrients and pathogen load in soil after harvest of maize and cowpea

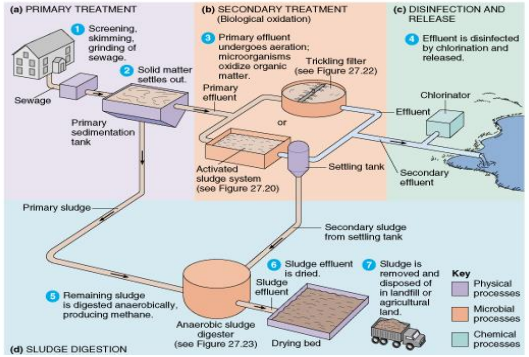
Characterization

Sludge - Ecosan



Sludge – Pit latrine

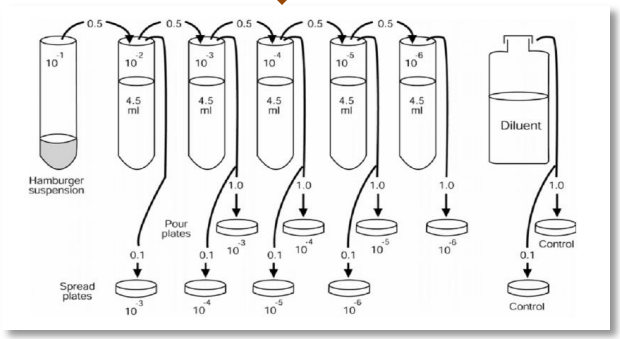
Sludge – STP



Parameters	Humanure	Pit toilet sludge	Sewage sludge
pH (1:5)	8.47	6.01	5.95
EC (1:5) (dS/m)	4.47	1.62	1.12
Total carbon (%)	15.67	14.62	7.13
Nitrogen (%)	0.03	0.45	0.44
Phosphorus (%)	0.58	**0.77**	**1.06**
Potassium (%)	**2.26**	0.13	0.21
Calcium (%)	3.08	0.13	3.63
Magnesium (%)	5.65	2.54	8.34
Sulphur (%)	1.60	1.21	1.52
Iron (ppm)	9243.61	6717.00	9921.50
manganese (ppm)	432.42	308.86	469.51
Zinc (ppm)	476.61	400.72	457.19
Copper (ppm)	114.60	98.85	107.44
Cadmium (ppm)	19.91	17.92	13.13
Chromium (ppm)	62.63	56.38	54.25
Lead (ppm)	73.88	66.50	59.60
Nickel (ppm)	82.40	74.16	53.25

Enumeration of pathogenic micro organisms in manures and soil

Fresh manure or soil samples were collected in sterile bags



Micro organisms	media
E. Coli	EMB agar
Bacillus species	Nutrient agar
Salmonella	Bismuth sulphite agar
Staphylococcus aureus	Mannitol salt agar

Kept for Incubation

Manures	*E.Coli* 10^5 (cfu g^{-1})	*Bacillus spp* 10^6 (cfu g^{-1})	*Salmonella spp* 10^4 (cfu g^{-1})	*Staphylococcus aureus* 10^3 (cfu g^{-1})
Humanure	8.6	9.8	6.8	5.6
Pit toilet sludge	9.5	12.8	8.46	7.8
Sewage sludge	7.5	8.0	8.6	5.3
Initial soils	-	-	-	-

Field experiment

No. of experiments

Two

Place

Zonal Agricultural Research Station, Mandya, Karnataka, India

Crops

- **Main - Maize (Variety: Hema)**
- **Residual - Cowpea (Variety: KBC 2)**

Source		Maize (t ha^{-1})
Humanure	75% K	1.33
	100% K	1.78
	150% K	2.67
Pit toilet sludge	75% P	12.22
	100% P	16.34
	150% P	24.45
Sewage sludge	75% P	7.21
	100% P	9.58
	150% P	14.38

***Note**: Humanure applied on K basis*
Pit toilet sludge and sewage sludge applied on P basis.

The quantity of remaining nutrients supplemented through fertilizers to balance the recommended dose.

Experimental results

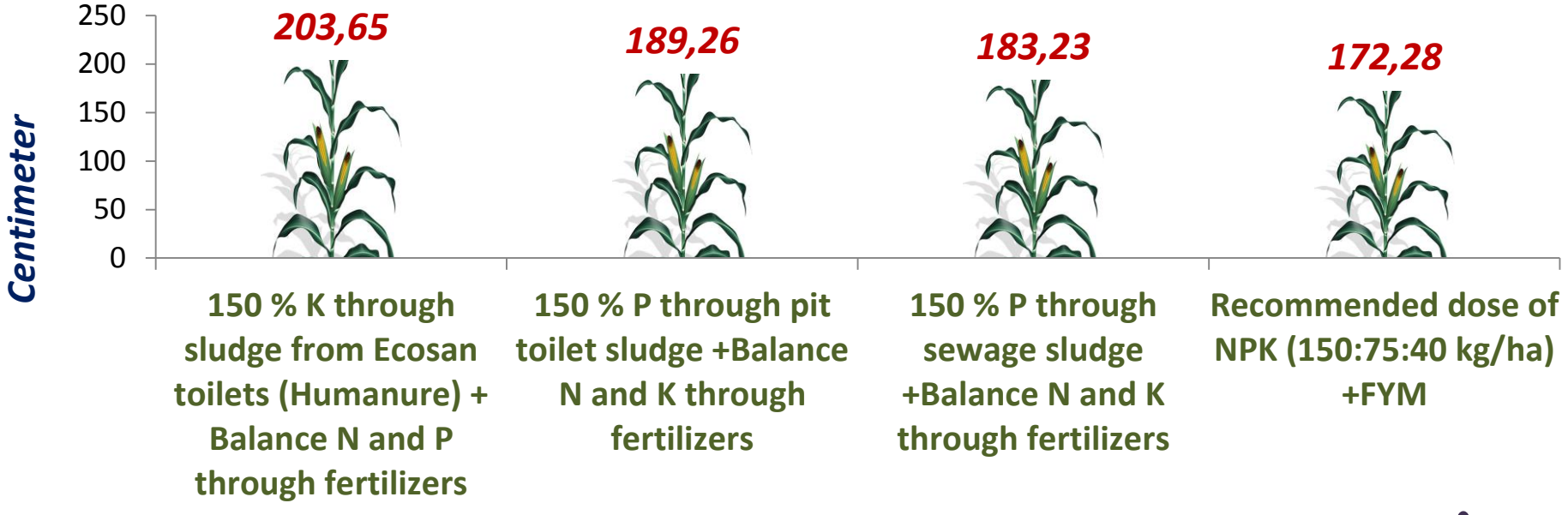
Initial properties of soil of the experimental site

Chemical properties	
pH (1:2.5)	6.80
EC (dS m^{-1})	0.13
OC (g kg^{-1})	0.57
CEC (c mol (p+) kg^{-1})	13.36
Available nitrogen (kg ha^{-1})	341.94
Available phosphorus (kg ha^{-1})	40.48
Available potassium (kg ha^{-1})	212.35
Exchangeable calcium (C mol (p+) kg^{-1})	5.20
Exchangeable magnesium (C mol (p+) kg^{-1})	1.90
Available sulphur (mg kg^{-1})	8.03
DTPA-Iron (mg kg^{-1})	16.11
DTPA-Manganese (mg kg^{-1})	12.08
DTPA-Copper (mg kg^{-1})	2.00
DTPA-Zinc (mg kg^{-1})	1.50
Hot water soluble Boron (mg kg^{-1})	0.56

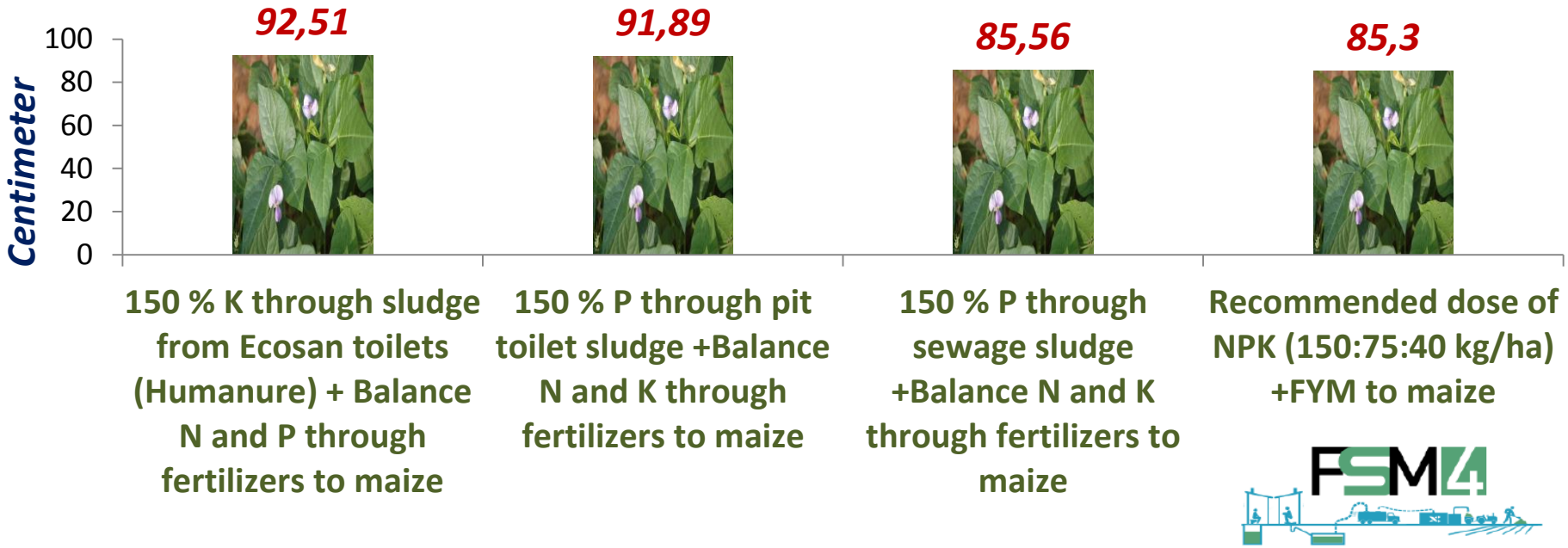
DTPA- Pb (mg kg^{-1})	0.65
DTPA-Cd (mg kg^{-1})	0.03
DTPA-Cr (mg kg^{-1})	ND
DTPA-Ni (mg kg^{-1})	0.52

Biological properties - Pathogens	
E.coli	-
Bacillus spp	-
Staphylococcus aureous	-
Salmonella-seigella	-
Total coliforms	$0.28X10^4$

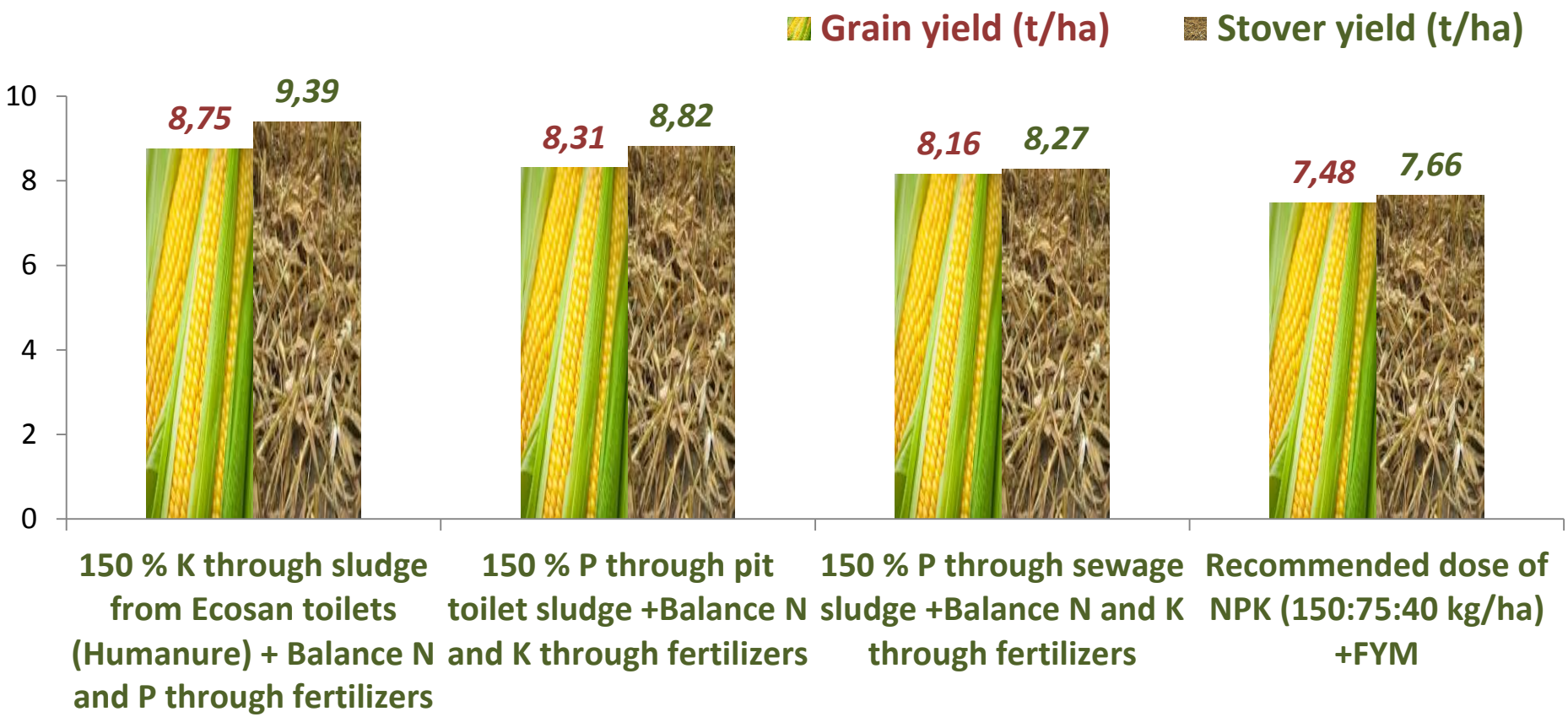
Maize plant height (in cm)



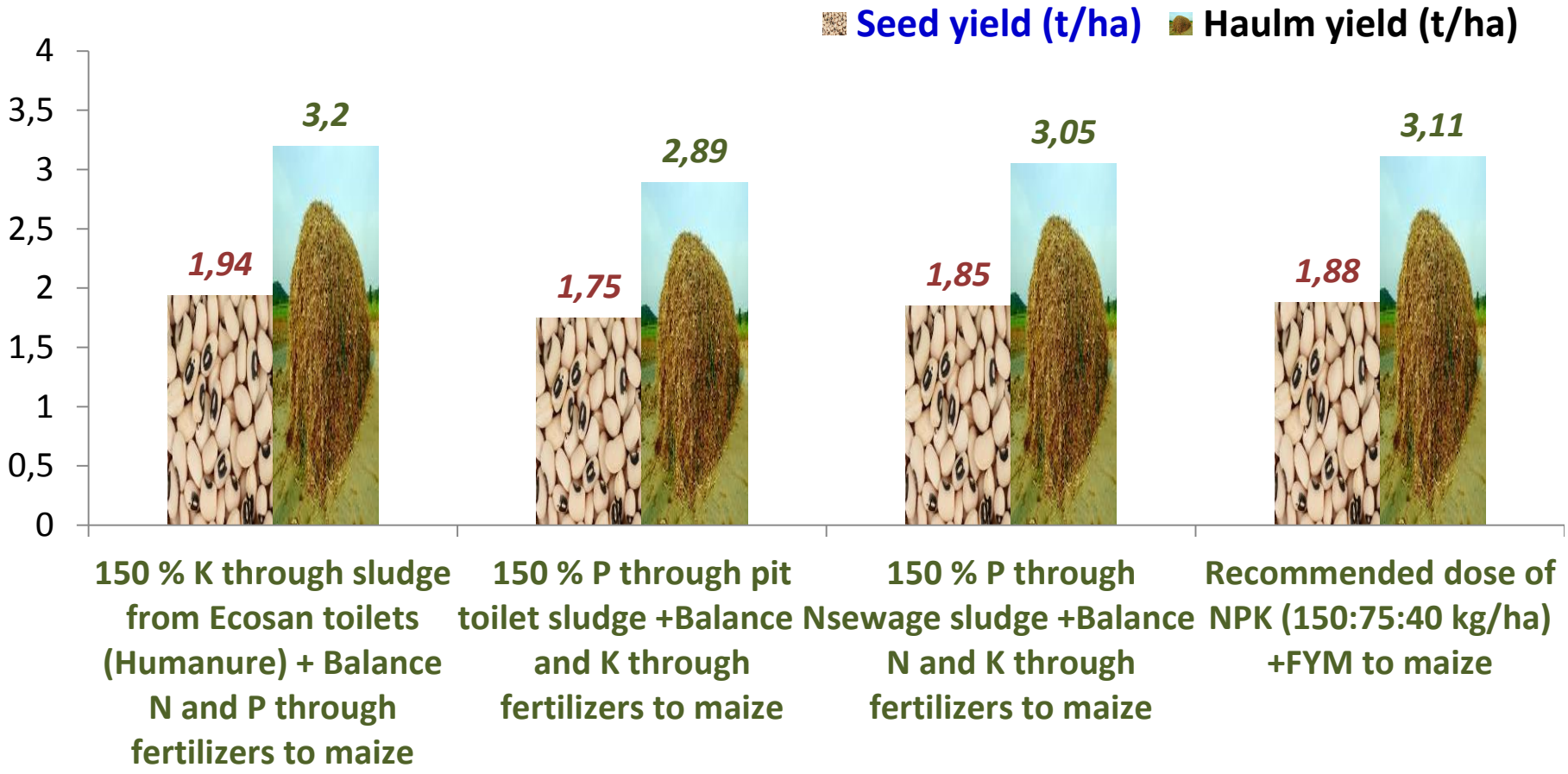
Residual effect on cowpea plant height (in cm)



Effect of Humanure, pit toilet sludge and sewage sludge on yield of maize (in t/ha)



Residual effect of Humanure, pit toilet sludge and sewage sludge on yield of cowpea (in t/ha)



Effect of humanure, pit toilet sludge and sewage sludge on chemical properties and major nutrients content of soil after harvest of maize crop

Treatments	pH (1:2.5)	EC (dS m^{-1})	OC (%)	Avail. N (kg ha^{-1})	Avail. P_2O_5 (kg ha^{-1})	Avail. K_2O (kg ha^{-1})
150% K through sludge from Ecosan toilets (Humanure) + balance N and P through fertilizers	7.01	0.36	0.81	394.78	64.63	339.94
150% P through pit toilet sludge + balance N and K through fertilizers	6.59	0.34	0.85	407.39	64.22	337.78
150% P through sewage sludge + balance N and K through fertilizers	6.54	0.33	0.82	398.02	62.86	330.62
Recommended dose of NPK (150:75:40 kg/ha) + FYM	6.93	0.23	0.80	394.75	53.34	280.55
SEm±	0.19	0.02	0.02	7.38	2.10	11.04
CD @ 5%	0.58	0.05	0.06	22.13	6.29	33.09

Residual effect of humanure, pit toilet sludge and sewage sludge on chemical properties and major nutrients content of soil after harvest of cowpea crop

Treatments	pH (1:2.5)	EC (dS m^{-1})	OC (%)	Avail. N (kg ha^{-1})	Avail. P_2O_5 (kg ha^{-1})	Avail. K_2O (kg ha^{-1})
150% K through sludge from Ecosan toilets (Humanure) + balance N and P through fertilizers to maize	7.09	0.37	0.43	202.52	49.12	156.37
150% P through pit toilet sludge + balance N and K through fertilizers to maize	6.72	0.35	0.45	208.99	48.80	155.38
150% P through sewage sludge + balance N and K through fertilizers to maize	6.67	0.34	0.44	204.18	47.77	152.08
Recommended dose of NPK (150:75:40 kg/ha) + FYM to maize	7.02	0.24	0.43	202.50	40.54	129.05
SEm±	0.37	0.02	0.01	3.40	1.70	5.08
CD @ 5%	1.11	0.05	0.03	10.20	5.09	15.22

Pathogenic microorganisms in plots applied with humanure, pit toilet sludge and sewage sludge after harvest of maize and cowpea

Treatments	*E. coli*		*Bacillus spp*		*Staphylococcus aureous*	
	Maize	Cowpea	Maize	Cowpea	Maize	Cowpea
150% K through sludge from Ecosan toilets (Humanure) + balance N and P through fertilizers to maize	-	-	+	-	+	-
150% P through pit toilet sludge + balance N and K through fertilizers to maize	-	-	+	-	+	-
150% P through sewage sludge + balance N and K through fertilizers to maize	-	-	+	-	+	-
Recommended dose of NPK (150:75:40 kg/ha) + FYM to maize	-	-	+	-	+	-

Conclusion

- **With dwindling fertilizer resources, alternate sources of nutrition need to be explored. Humanure is the best alternative source of nutrients to crops.**

- **Studies conducted for the first time, in India, clearly indicate the positive role of humanure, pit toilet sludge and sewage sludge along with inorganic fertilizers in improving soil fertility and yield of crops.**

Acknowledgement

The authors acknowledge Arghyam, NGO, Bengaluru, India for the financial support and UAS, Bengaluru for providing physical facilities.


Thank You