Boosting Sugarcane Productivity By Recycling Crop And Industry Residues

(trash, stubbles, filter-cake)

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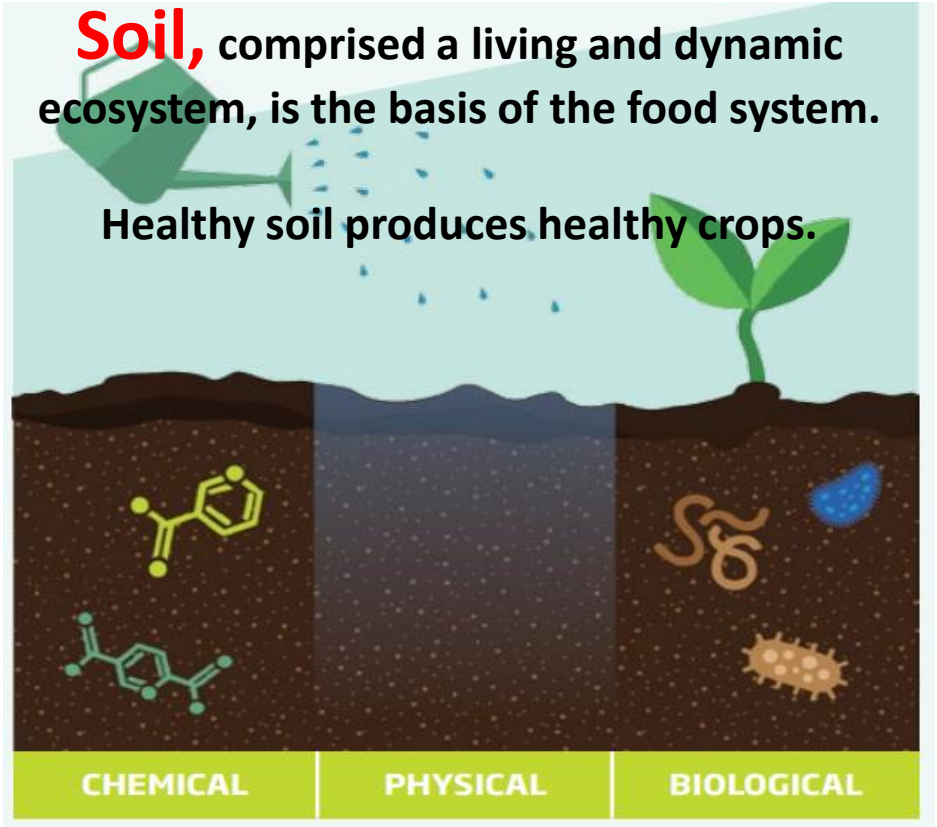
Why Organic Matter (OM)?

Organic Material: A pile plant and animal material such as leaves, manure and other organic wastes in the soil is not OM, but organic material. It is >1 %

Organic Matter: Organic material, when acted upon by various soil microbes and decomposed into humus becomes OM. It is < 0.6%

- Organic material is unstable OM is stable form.
- SOM comprises microbes (10-40%) and stable organic compounds (40-60%).

- **CHEMICAL:**
  - Improves the soil's capacity to restore, store and supply essential nutrients.
  - It allows the soil to cope with changes in soil alkalinity/acidity.
- **PHYSICAL:**
  - Soil structure.
  - Water retention: up to 90% of its weight that is available to plants
  - Soil erosion, Water infiltration & water holding capacity.
- **BIOLOGICAL:**
  - Primary source of carbon (C): gives energy and nutrients to soil organisms.
  - It supports soil functionality by improving activity of microorganisms i.e., soil biodiversity.
  - Mitigates climate change: C- sequestration in the soil lowers emissions of CO_2 to the atmosphere.



Some facts about fertilizers use

For sugarcane growing

- **60% farmers use less than 3 bags of urea per acre**
- **70% farmers less than 2 bags of DAP**
- **90% farmers do not use Potash**

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- (Source: Annual Report 2004-05 NIINMS, Sugar Crops, NARC)

Some facts about Soil

In Jhang & Sargodha districts:

- All the soils are deficient in plant available N (<11 mg kg^{-1} NO_3-N)
- 98% soils ---- in P (<4 mg kg^{-1})
- 45% soils ---- in K (<125 mg kg^{-1})
- 60% soils ---- in B (<0.50 mg kg^{-1} HCl extr. B)
- 92% soils ---- in Zn (<1.0 mg kg^{-1})

(Source: Annual Report 2004-05 NIINMS, Sugar Crops, NARC)

Sugarcane

- Sugarcane is one of the **top-most promising agricultural sources of biomass producer** in the world.
- According to the *International Sugar Organization (ISO)*, Sugarcane is a highly efficient converter of solar energy.
- Sugarcane can return about 15-20 ton ha^{-1} of organic matter, containing 6-8 ton ha^{-1} of carbon to the soil surface (**Thangarajan et al., 2013**).
- Sugarcane comprised mainly following biomass:
  - **Cane Trash:** field residue remaining after harvesting the Cane stalk.
  - **Cane Stubbles:** underground field residue remaining after harvesting the Cane stalk.
  - **Cane Juice:** comprised water, sugars, minerals etc.
  - **Mill Bagasse:** by-product which remains after extracting sugar from the stalk
  - **Mill press mud:** Waste removed during purifying sugarcane juice

Sugarcane Trash

- It represents about 15% of the total above ground biomass at harvest.
- During harvesting operation around 70-80% of the cane trash is left in the field.

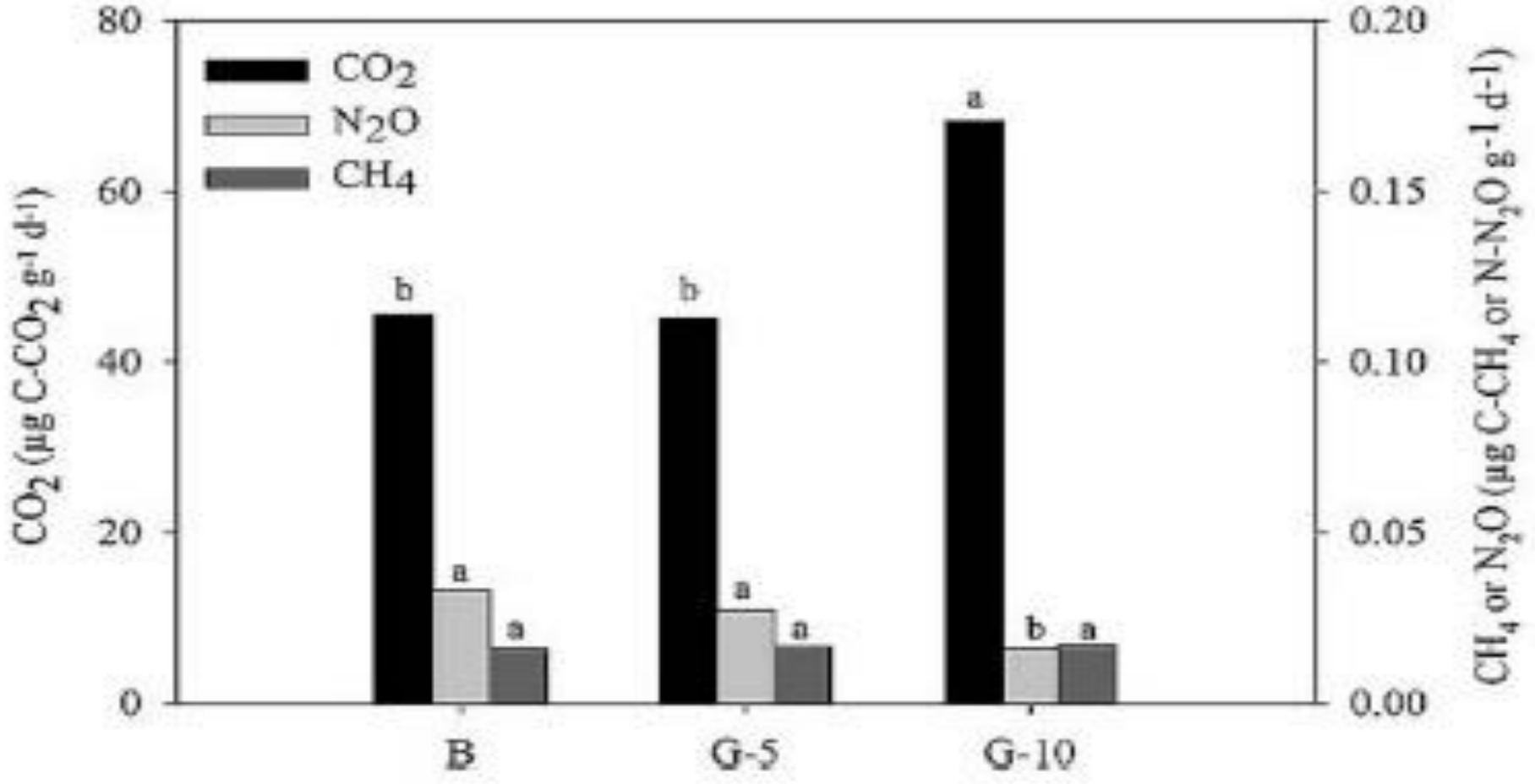
Trash Management.

- **Burning the trash**

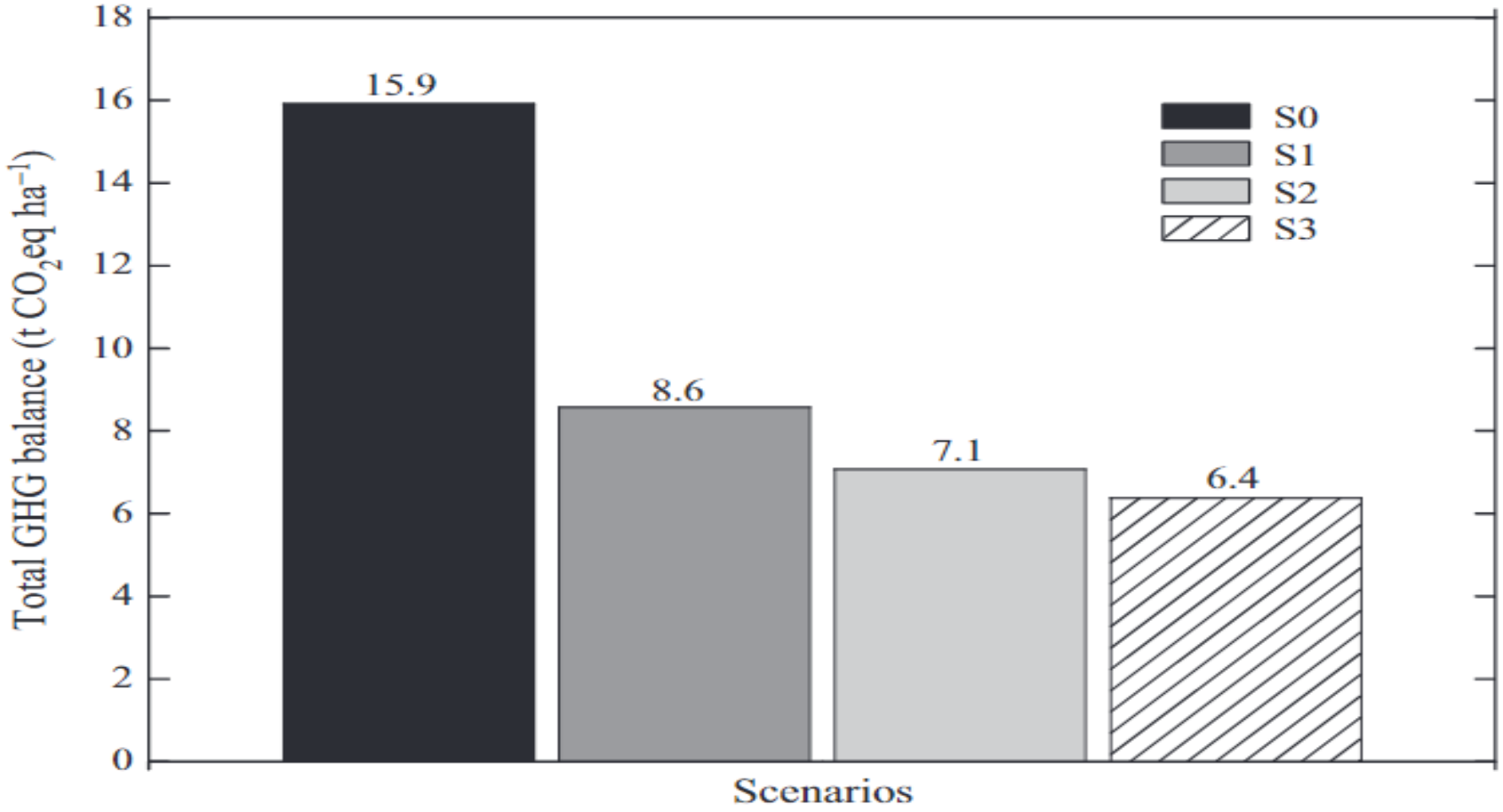
Most deleterious method: Pollution

Easy in field operations

Sources of GHG (N_2O, CO, CO_2)



Predicted average production rate of CO_2, N_2O, and CH_4 in the burned sugarcane (B), green sugarcane for 5 years (G-5), and green sugarcane for 10 years (G-10) ---- (Tavares, 2018)



Total balance of greenhouse gases emissions (in ton CO2eq ha^{-1}) for sugarcane production scenario for 6 years --- (Bordonal et al, 2012)

S0: a burned harvest + conventional tillage, **S1**: green harvest + conv. tillage,
S2: green harvest + reduced tillage and **S3**: green harvest +reduced tillage + a crop rotation with *Crotalaria juncea* L.

Sugarcane Trash Management

- Use as mulch for moisture conservation.
- Incorporating trash in soil for moisture and nutrients

Trash Blanket: moisture conservation

Trash Incorporation: decompose --- Sources of OM, Nutrients, moisture retention

K requirements reduced by 25-30 Kg/ha

N requirement reduced by 50-60 Kg/ha

Comparison of Trash Blanket and Burning

Treatment	Cane yield t/ha
Trash lined in alternate inter rows	88.7
Trash blanket	95.1
Trash burning	83.9

Source : Mcintyre etal 1996

Cane Trash on Decomposition Adds to the Soil

- 5.3 kg N per ton of trash
- 1.1 kg P per ton of trash
- 5.8 kg K per ton of trash

- Incorporating 5 tones trash with 75 kg N fertilizer increased cane yield by 37.5 %
- Fertilizer dose reduced by 50 %

Source : Verma, 2002

Sugarcane Stubbles management ???

Site of important microbiota: Mycorrhizea, Bacteria, Fungi, P solublizers

Source of soil OM, Nutrients for plants and & C for MO

Stubble Incorporation

Left over stubbles :	**5-10 ton/ha**	
Roots :	**3-6 ton/ha**	
Nutrients ha:		
N	**50-100 kg**	**Burning /Removal results in lose of O.M & nutrients, and No. of microbiota**
P	**5-10 kg**	
K	**30-90 kg**	
Ca	**30-50 kg**	
Mg	**15-25 kg**	
S	**8-18 kg**	

Filter-cake/Press mud Management

Filter-cake/Press mud Management

Production & application estimate

YEAR	Sugarcane Area (000 acres)	PM Production (000 ton)	Estimate (50% area) (ton/acre)
2018-19	2719	1490	1.09
2019-20	2564	1441	1.12
2020-21	2875	1758	1.22
2021-22	3112	2064	1.32

Composition of different manures (kg/ton)

Manure type	OM	Total N	P_2O_5	K_2O
Chicken Manure (fresh, broiler, layer etc)		13-36	8-40	6-23
FYM		20-25	6-8	5-6
Pressmud	550-600	15-16	11-13	7-10

Effect of fertilizers & PM on Cane yield

Practice	Yield (Md/Acre)	Difference (md/Acre)
Farmers Practice	625	--
Recommended fertilizer (NPK, Zn and B)	720	95
Half NPK +Zn and B and 4 ton PM (DWB)	765	140

(Source: Final Report 2004-08 ALP-NIINMS Project, Sugar Crops, PARC)

Effect of press mud on physico-chemical characteristics of the soil

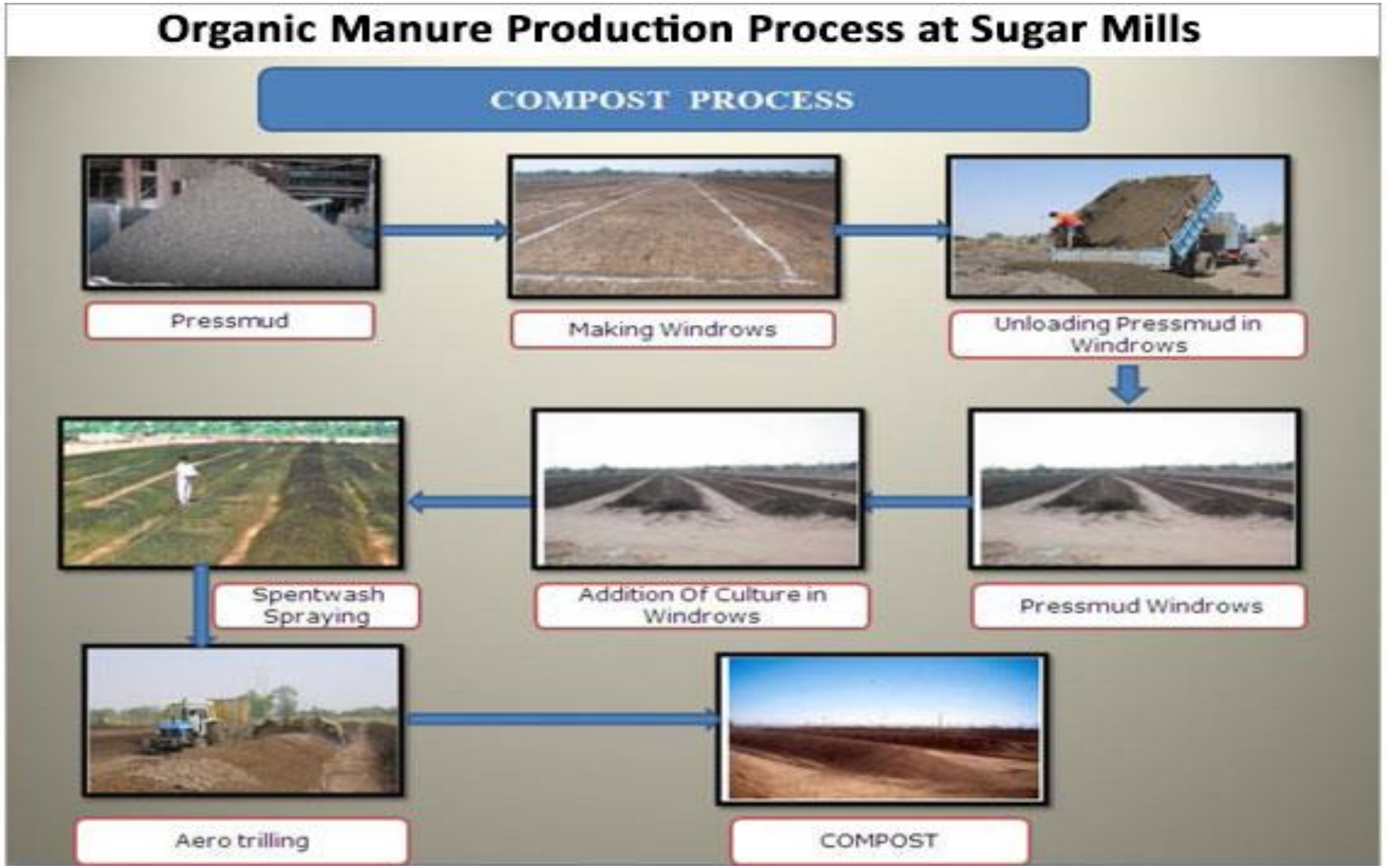
Treatments	Physico-chemical characteristics of the Sandy loam soil						
	Bulk Density ($g\ cm^{-3}$)	pH	EC_e ($dS\ m^{-1}$)	O.M. %	Total N ($mg\ kg^{-1}$)	Avail. P ($mg\ kg^{-1}$)	Avail. K ($mg\ kg^{-1}$)
No PM	1.32	8.1	0.39	0.800	310	8	161
PM 2 t ha^{-1}	1.32	8.1	0.42	0.816	400	52	186
PM 4 t ha^{-1}	1.32	8.0	0.42	0.830	460	106	205
PM 10 t ha^{-1}	1.30	7.9	0.50	0.848	680	220	234

(Ghulam *et al.*, 2010, D.I. Khan)

BIOCOMPOSTING

It is a process to treat PM with effluent
making an environment
friendly stable product
which could increase
the productivity of
Soils and Plants

Organic Manure Production Process at Sugar Mills



Effect of enriched pressmud (pleorotus & trichoderma fungi) & bio-compost on yield and quality of Sugarcane

Treatments	CCS %	Cane yield t/ha
100% NPK	12.45	84.3
75% NPK	12.49	70.3
75% NPK + EPM-P (10 t/ha)	13.51	86.7
75% NPK + BC (10 t/ha)	13.40	86.0
CD (P=0.05)	NS	9.40**

(Rakkiyappan et al., 2001)

THANKS