Fractionation of Phosphorus Accumulated at Plastic Film House Soils

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Motivation

❖ Intensive manure application increased gradually the phosphorus(P) content in plastic film house soil in South Korea.

Fig. Scenes of livestock manure input (left) and phosphorus accumulation at on-farm fields (right).

❖ It is necessary to study the phosphorus accumulated in plastic film house soils to develop effective remediation strategies to minimize phosphorus accumulation in agricultural lands and environmental pollution,

Objective

❖ The objective of this study was to characterize the complex forms of phosphorus accumulated in plastic film house soils

Materials and methods

❖ Soils sampling from on-farm fields applied successively with livestock manures for 3 ~10 years.

Table. Chemical characteristics of soils under study.

Soils	Number of samples	pH (1:5H_2O)	EC (dS m^{-1})	OM (g kg^{-1})	Lancaster P_2O_5 (mg kg^{-1})	Ca	K	Mg	Na
						cmol $_c$ kg^{-1}			
Pig manure treatment	5	7.1	7.94	44	1,134	12.4	4.62	7.5	2.40
Poultry manure treatment	5	6.9	2.73	38	1,013	12.3	1.37	6.5	1.78
Diary manure treatment	4	6.5	7.24	34	1,113	12.5	3.01	3.2	0.23
Optimum range for crops growth		6.0~7.0	≤ 2.00	20~30	350~500	5.0 ~7.0	0.70 ~0.80	1.5 ~2.5	-

➢ Phosphate content of soils was about 2 times higher than optimum range for crop growth.

Table. Chemical properties of livestock manures taken from farms.

manures type	Number of sample	T-N	P_2O_5	CaO	Fe	Al
		%				
Pig manure	3	1.29	2.15	3.64	0.33	0.06
Poultry manure	3	1.47	1.69	5.47	0.43	0.40
Diary manure	4	0.83	1.20	1.73	0.24	0.30

➢ The concentration of P_2O_5 was the order of pig > poultry > diary manure and CaO is the highest among elements.

❖ Methods of analysis

- Phosphorus fractionation(SSSAJ, 1996)
  - T-P : $NaHCO_3$
  - Organic –P: Ignition
  - Inorganic-P : Modified Chang & Jackson - XRD and SEM-EDS
- XRD and SEM-EDS

Results

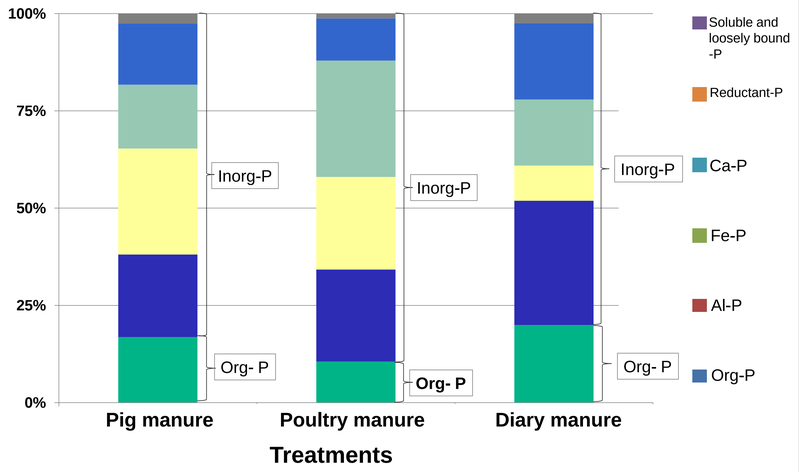

Fig. Phosphorus fractionation of soils treated with livestock manures.

➢ Inorganic P was dominant as 83~88% of T-P in three types of soils.

➢ T-P content of diary manure treatment was higher than other treatments because the input of diary manure was high comparing other manures.

➢ Fe bound P, Al bound P and Ca bound P was the highest in soils applied pig manure, diary manure, and poultry manure, respectively.

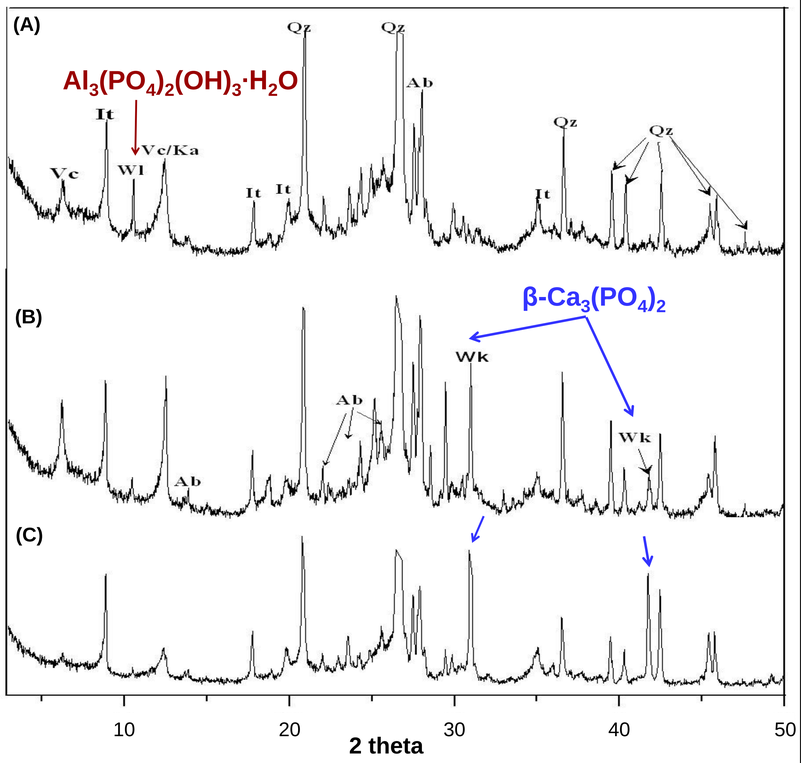

Fig. Analysis of XRD with soils treated pig manure(A), poultry(B), and diary manure(C).

➢ β-$Ca_3(PO_4)_2$(β-tricalcium phosphate) as phosphate precipitates was identified in soils applied diary and poultry manure.

➢ It was estimated that $Al_3(PO_4)_2(OH)_3 \cdot H_2O$ was originated from pig manure because precipitation reactions occurs near the high concentration of fertilizers.

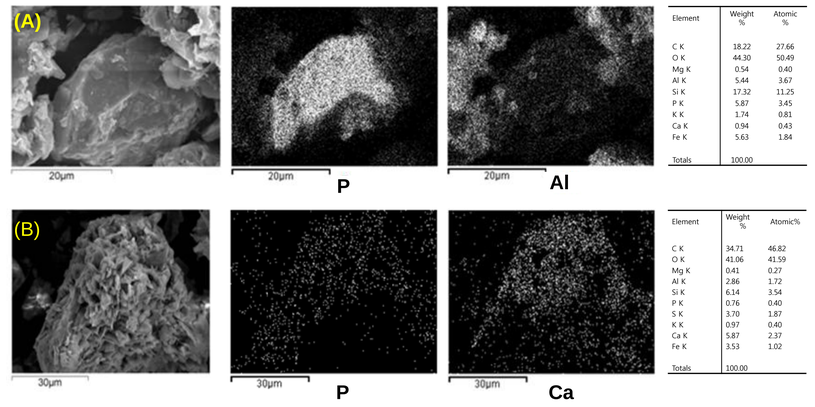

Fig. Scanning electron micrographs of soils treated pig manure(A) and poultry manure(B) .

➢ Phosphorus combined Al was found in soil with pig manure and Ca-P, in both poultry and diary manure.

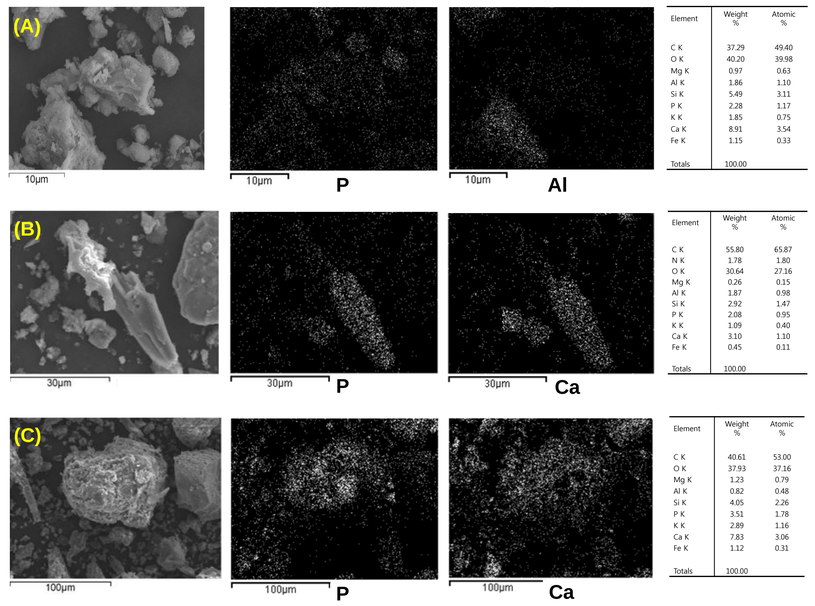

Fig. Scanning electron micrographs of pig manure(A) and poultry manure(B) , and diary manure(C).

➢ Phosphorus combined Al and Ca were found in pig manure and both poultry and diary manure, respectively.

Conclusions

❖ Chemical fraction of phosphorus with soils applied livestock manures varied the dominant forms combined phosphorus.

❖ It was predicted that phosphate precipitates occurred as the content of phosphorus increased at plastic film house soils where livestock manures were applied continuously.

References

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