SUPPLEMENTARY MATERIALS

Table S1. Details of reagents used in the study

Reagent name	Chemical name	Manufacturer
Nitrogen gas	N_2	北海道エア　ウオーター株式会社, Hokkaido, Japan
Potassium dichromate	$K_2Cr_2O_7$	Ajex Finechem Pty Ltd, Albany, Auckland, New Zealand
Sulfuric acid	H_2SO_4	Merck KGaA, Darmstadt, Germany
1-10-phenanthroline Monohydrate	$C_{12}H_8N_2 \bullet H_2O$	Kemaus Chemical, Cherryblook, Australia
Ferrous sulphate	$FeSO_4 \bullet 7H_2O$	Ajex Finechem Pty Ltd, Newmarket, Auckland, New Zealand
Potassium dihydrogen orthophosphate	KH_2PO_4	BDH Laboratory Supplies, Poole, England
Hydrochloric acid fuming	HCl	Merck KGaA, Darmstadt, Germany
Ammonium fluoride	NH_4F	Merck KGaA, Darmstadt, Germany
Ammonium molybdate	$(NH_4)_6Mo_7O_{24} \bullet 4H_2O$	Kemaus Chemical, Cherryblook, Australia
L-Ascorbic acid	$C_6H_8O_6$	Ajex Finechem Pty Ltd, Newmarket, Auckland, New Zealand
Ammonium acetate	CH_3COONH_4	Kemaus Chemical, Cherryblook, Australia
2- propanol (Isopropyl alcohol, 99%)	$(CH_3)_2CHOH$	Wako Pure Chemical Industries, Ltd, Osaka, Japan
Ammonium chloride	NH_4Cl	Ajex Finechem Pty Ltd, Albany, Auckland, New Zealand
Ammonium oxalate	$(NH_4)_2(COO)_2 \bullet H_2O$	Kemaus Chemical, Cherryblook, Australia
Ammonium hydroxide	NH_4OH	Carlo Erba Reagents S.A.S, Val de Reuil, Cedex, France
Silver nitrate	Ag_3NO_3	GemChem chemical & laboratory reagents, Maharashtra, India
10% Sodium chloride acidified	NaCl	Merck KGaA, Darmstadt, Germany
Sodium Hydroxide	NaOH	Merck KGaA, Darmstadt, Germany
Boric acid	H_3BO_3	Ajex Finechem Pty Ltd, Newmarket, Auckland, New Zealand
Sulfuric acid	H_2SO_4	Merck KGaA, Darmstadt, Germany
Methyl red	$C_{15}H_{15}N_3O_2$	Alpha chemika, Mumbai, India
Ethanol	C_2H_5OH	Merck KGaA, Darmstadt, Germany
Bromocresol green	$C_{21}H_{14}Br_4O_5S$	Fisher Scientific UK Limited, Leicestershire, UK
Standard Solution of Potassium, Sodium, Calcium, and Magnesium	K, Na, Ca, and Mg	Merck KGaA, Darmstadt, Germany

Table S1. Details of reagents used in the study (continue)

Reagent name	Chemical name	Manufacturer
Sulfuric acid	H_2SO_4	Merck KGaA, Darmstadt, Germany
Boric acid	H_3BO_3	Ajex Finechem Pty Ltd, Newmarket, Auckland, New Zealand
Sodium hydroxide	NaOH	Merck KGaA, Darmstadt, Germany
Methyl red	$C_{15}H_{15}N_3O_2$	Alpha chemika, Mumbai, India
Trisodium Phosphate 12-water	$Na_3PO_4 \bullet 12H_2O$	Fujifilm Wako Pure Chemical Cooperation, Osaka, Japan
Sodium Hydroxide	NaOH	Fujifilm Wako Pure Chemical Cooperation, Osaka, Japan
Potassium Chloride	KCl	Fujifilm Wako Pure Chemical Cooperation, Osaka, Japan
Ethylenediamine- N,N,N',N-tetraacetic acid, disodium salt, dihydrate	$C_{10}H_{14}N_2O_8 \bullet 2H_2O$	Wako Pure Chemical Industries, Ltd, Osaka, Japan
Sodium Pentacyanonitrosyl ferrate (III) Dihydrate	$Na_2Fe(CN)_5NO \bullet 2H_2O$	Wako Pure Chemical Industries, Ltd, Osaka, Japan
Ammonium Ion Standard Solution	NH_4^+	Wako Pure Chemical Industries, Ltd, Osaka, Japan
Hydrogen peroxide	H_2O_2	Fujifilm Wako Pure Chemical Cooperation, Osaka, Japan
Sodium Hexametaphosphate	$(NaPO_3)_6$	Fujifilm Wako Pure Chemical Cooperation, Osaka, Japan
1,10 Phenanthroline, monohydrate	$C_{12}H_9ClN_2 \bullet H_2O$	Wako Pure Chemical Industries, Ltd, Osaka, Japan
Ammonium acetate	NH_4CH_3CO	Wako Pure Chemical Industries, Ltd, Osaka, Japan
Acetic acid	CH_3COOH	Wako Pure Chemical Industries, Ltd, Osaka, Japan
Hydroxylammonium chloride	$HONH_3Cl$	Wako Pure Chemical Industries, Ltd, Osaka, Japan
Ammonium Iron (II) sulfate 6-water	$(NH_4)_2Fe(SO_4)_2(H_2O)_6$	Wako Pure Chemical Industries, Ltd, Osaka, Japan
Potassium hydrogen phthalate	$C_8H_5KO_4$	Wako Pure Chemical Industries, Ltd, Osaka, Japan
Sodium carbonate decahydrate	$CH_{20}Na_2O_{13}$	Wako Pure Chemical Industries, Ltd, Osaka, Japan
Manganese standard solution	Mn	Wako Pure Chemical Industries, Ltd, Osaka, Japan

Table S2. Soil characteristics and analysis method before and after soil incubation.

Before incubation		After incubation	
Soil parameters	**Methods**	**Soil parameters**	**Methods**
Soil pH (1:10) (BI)	pH parameter	Soil pH (1:10) (AI)	pH parameter
1:10 EC (BI) ($mS.m^{-1}$)	EC parameter	1:10 EC (AI) ($mS.m^{-1}$)	EC parameter
Avail.P ($mg.kg^{-1}$)	Bray II method	SO_4^{2-} -S (AI), NO_3^- -N (AI), Cl^- (AI), PO_4^{3-} -P (AI) ($mg\ kg^{-1}$)	Ion chromatography system (DIONEX ICS-1100)
SO_4^{2-} -S (BI), NO_3^- -N (BI). Cl^- (BI), PO_4^{3-} -P (BI) ($mg.kg^{-1}$)	Ion chromatography system (DIONEX ICS-1100)	Mn^{2+} ($mg.kg^{-1}$)	Z-5010 polarized Zeeman atomic absorption spectrophotometer
CEC ($cmol.kg^{-1}$), Exchangeable base cations ($mg.kg^{-1}$), Base saturation (%)	Schollenberger method	$ExNH_4$ (AI) ($mg.kg^{-1}$)	1M KCl extraction, Indophenol-blue method
SOC (%) and SOM (%)	Walkley-Black acid digestion method	Fe^{2+} ($mg.kg^{-1}$)	Phenanthroline method
TN (%)	Kjeldahl method	WSOC ($mg.kg^{-1}$)	TOC-5000A total organic carbon analyzer
Saturated hydraulic conduct	Fall head method		
Soil texture (%)	Pipette method		
$ExNH_4$ (BI) ($mg.kg^{-1}$)	1M KCl extraction, Indophenol-blue method		

(BI) indicates result before incubation, and (AI) indicates result after incubation. Where EC, electrical conductivity; SOC, soil organic carbon; SOM, soil organic matter; WSOC, water-soluble organic carbon.

Table S3. Correlation matrix for CH_4 production potential (CH_4PP) and soil properties (before incubation)

	CH_4PP	pH_{BI}	EC_{BI}	OM	OC	Avail.P	ExK	ExCa	ExMg	ExNa	Total.N	CEC	BS	Cl^-	NO_3^-	PO_4^{3-}	SO_4^{2-}	$ExNH_{4(BI)}$	Sand	Silt
CH_4PP																				
pH_{BI}	.07																			
EC_{BI}	-.09	-.78**																		
SOM	.13	-.75**	.82**																	
SOC	.13	-.75**	.82**	1.0**																
Avail.P	-.05	-.06	.10	.11	.11															
ExK	-.05	-.72**	.80**	.86**	.86**	.18														
ExCa	-.15	-.64**	.65**	.80**	.80**	.14	.88**													
ExMg	-.14	-.57**	.70**	.74**	.74**	.17	.85**	.87**												
ExNa	-.08	-.62**	.76**	.72**	.72**	.15	.85**	.80**	.84**											
Total.N	-.14	-.71**	.78**	.83**	.83**	.16	.79**	.77**	.77**	.78**										
CEC	-.10	-.66**	.74**	.88**	.88**	.04	.86**	.92**	.79**	.79**	.79**									
BS	-.18	-.14	.15	.08	.08	.36*	.36*	.37*	.53**	.38*	.20	.05								
Cl^-	-.17	.09	-.10	-.18	-.18	-.14	-.19	-.19	-.12	-.12	-.16	-.20	.02							
NO_3^-	.14	.17	-.25	-.36*	-.36*	-.05	-.37*	-.46**	-.41**	-.34*	-.40**	-.47**	-.11	-.11						
PO_4^{3-}	.09	.21	-.13	-.18	-.18	.17	-.15	-.21	-.17	-.10	-.20	-.24	.30*	-.06	-.09					
SO_4^{2-}	.13	-.67**	.58**	.73**	.73**	.06	.59**	.48**	.33*	.51**	.56**	.65**	-.20	-.16	-.25	-.13				
$ExNH_{4(BI)}$	.31*	-.41**	.27	.41**	.41**	-.02	.38*	.35*	.24	.18	.15	.36*	-.03	-.12	-.22	-.13	.31*			
Sand	.16	.66**	-.62**	-.81**	-.81**	.00	-.73**	-.84**	-.69**	-.67**	-.77**	-.91**	.04	.04	.53**	.34*	-.58**	-.40**		

Silt	-.14	-.66**	.61**	.82**	.82**	.01	.72**	.83**	.68**	.64**	.79**	.89**	-.04	-.06	-.51**	-.34*	.58**	.42**	-.99**	
Clay	-.19	-.63**	.60**	.76**	.76**	-.01	.72**	.82**	.68**	.68**	.72**	.91**	-.05	-.01	-.54**	-.33*	.56**	.36*	-.98**	.93**

* Correlation is significant at the $P < 0.05$ level (2-tailed).

** Correlation is significant at the $P < 0.01$ level (2-tailed).