

SUPPORTING INFORMATION

Title: **Effects of dazomet fumigation on soil phosphorus and the composition of *phoD*-harboring microbial community**

Author: Bin Huang^a, Dongdong Yan^{a,c}, Qiuxia Wang^{a,c}, Wensheng Fang^a, Zhaoxin Song^a, Hongyan Cheng^a, Yuan Li^{a,c}, Canbin Ouyang^{a,c}, Qingli Han^d, Xi Jin^{b,*}, Aocheng Cao^{a,c,*}

^aInstitute of Plant Protection, Chinese Academy of Agricultural Sciences, Beijing 100193, China

^b IPPCAAS-BU Joint Research Centre for Soil Remediation, Baoding University, Hebei, 071000, China

^c Beijing Innovation Consortium of Agriculture Research System, Beijing, 100193, China

^d College of Biodiversity Conservation, Southwest Forestry University, Kunming, 650224, China

*Correspondence to: Aocheng Cao, No.2 West Yuanmingyuan Road, Institute of Plant Protection, Chinese Academy of Agricultural Sciences, Beijing 100193, China; Email: caoac@vip.sina.com. Xi Jin, No.3027 East Qiyi Road, Baoding, Hebei Province, China; Email: jinxi2007@126.com

Phone: +8610-62815940; Fax: +8610-62894863

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Table S1. The main physicochemical characteristics of Shandong, Miyun and Sichuan soils.

| Soil site | GPS coordinates | Sand (%) | Silt (%) | Clay (%) | NH ₄ ⁺ -N (mg kg ⁻¹) | NO ₃ ⁻ -N (mg kg ⁻¹) | Available phosphorus (mg kg ⁻¹) | Organic matter (g kg ⁻¹) | pH |
|-----------|------------------|----------|----------|----------|--|--|---|--------------------------------------|------|
| Shandong | 36°21'N,119°03'E | 39.5 | 49.7 | 10.8 | 9.23 | 57.08 | 283.4 | 21.93 | 7.33 |
| Miyun | 40°23'N,116°48'E | 66.8 | 26.6 | 6.6 | 11.82 | 42.15 | 382.7 | 11.21 | 6.22 |
| Sichuan | 27°49'N,102°11'E | 23.5 | 65.9 | 10.6 | 4.22 | 19.35 | 21.6 | 20.33 | 4.93 |

A dichromate digestion method was used to determine the content of the organic matter¹, and the pipette method was used to determine the soil mechanical properties². The pH was measured in a 1:2.5 soil to H₂O extract. Nitrogen content was determined using a FOSS Kjeltec 2300 Analyzer Unit (FOSS Analytical, Hillerød, Denmark). Phosphorus was determined by UV spectroscopy (UV 2102PC spectrophotometer; UNICO, Dayton, NJ, USA)³. The Shandong, Miyun soil used in this manuscript were the same as the reference 4.

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Table S2. Changes in the *phoD* microbe biomarker, which is sensitive to dazomet fumigation treatment, as shown by LEfSe analysis

| Days | Phylum | Class | Order | Family | Genus | Treatment |
|------|--------------------|---------------------|-------------------|--------------------------------|-----------------|-----------|
| 1 | | | | Mycobacteriaceae | Mycobacterium | DZ-H |
| | | | | Burkholderiaceae | Burkholderia | DZ-H |
| | Verrucomicrobia | Opitutae | Opitutales | Opitutaceae | Lacunisphaera | DZ-H |
| | Proteobacteria | Gammaproteobacteria | Pseudomonadales | Pseudomonadaceae | Pseudomonas | DZ-L |
| | | | | | Pseudohongiella | CK |
| 7 | | Gammaproteobacteria | | | | DZ-L |
| | | Rubrobacteria | Rubrobacterales | Rubrobacteraceae | Rubrobacter | CK |
| | | | | | Ruegeria | CK |
| | | | | | Labrenzia | CK |
| 14 | | | | Enterobacterales | Enterobacter | DZ-H |
| | | | | Enterobacteriaceae | Cronobacter | DZ-H |
| | | | Micrococcales | Micrococcaceae | Arthrobacter | DZ-L |
| | | | Glycomycetales | Glycomycetaceae | Stackebrandtia | DZ-L |
| | | | | unclassified_o_Burkholderiales | Mitsuaria | DZ-L |
| | | | | | Lysobacter | DZ-L |
| | | | | Rhizobiaceae | | DZ-L |
| | | | | | Ralstonia | DZ-L |
| | Kiritimatiellaeota | Kiritimatiellae | Kiritimatiellales | Kiritimatiellaceae | Kiritimatiella | CK |
| | | | | Hyphomicrobiaceae | | CK |

| Days | Phylum | Class | Order | Family | Genus | Treatment |
|------|---------------------------|---------------------------------|--------------------------------|----------------|-------|-----------|
| 60 | Actinobacteria_d_Bacteria | Actinobacteria_p_Actinobacteria | | | | DZ-H |
| 86 | Gammaproteobacteria | Pseudomonadales | Pseudomonadaceae | Rhodoplanes | DZ-H | |
| | | Rhodospirillales | Rhodospirillaceae | Mesorhizobium | DZ-L | |
| | | Rhodobacterales | Rhodobacteraceae | Labrenzia | DZ-L | |
| | | | unclassified_o_Burkholderiales | Pseudomonas | DZ-H | |
| | | | | Azospirillum | DZ-L | |
| | | | | Herbaspirillum | DZ-L | |
| | | | | Labrenzia | CK | |
| | | | | Rhizobacter | CK | |
| | | | | Mitsuaria | CK | |
| | | | | Lysobacter | CK | |

Table S3. Correlation coefficient and significance test of each environmental factor affecting the ranking result.

| | First axis | Second axis |
|------------------------|------------|-------------|
| <i>phoD</i> | 0.9687 | 0.2482 |
| <i>16s rRNA</i> | 0.0302 | -0.9995 |
| ALP | 0.8787 | 0.4773 |
| MB-P | 0.2915 | 0.9566 |
| Available-P | -0.5984 | -0.8012** |
| H ₂ O-P | -0.3952 | -0.9186* |
| NaHCO ₃ -Pi | -0.8031 | 0.5958 |
| NaHCO ₃ -Po | -0.3497 | -0.9369 |
| NaOH-Pi | -0.9061 | -0.4231 |
| NaOH-Po | 0.57 | 0.8217 |
| HCl-P | -0.6587 | -0.7524 |
| Residual-P | -0.1461 | -0.9893 |

ALP = alkaline phosphatase; MB-P = Microbial Biomass P.

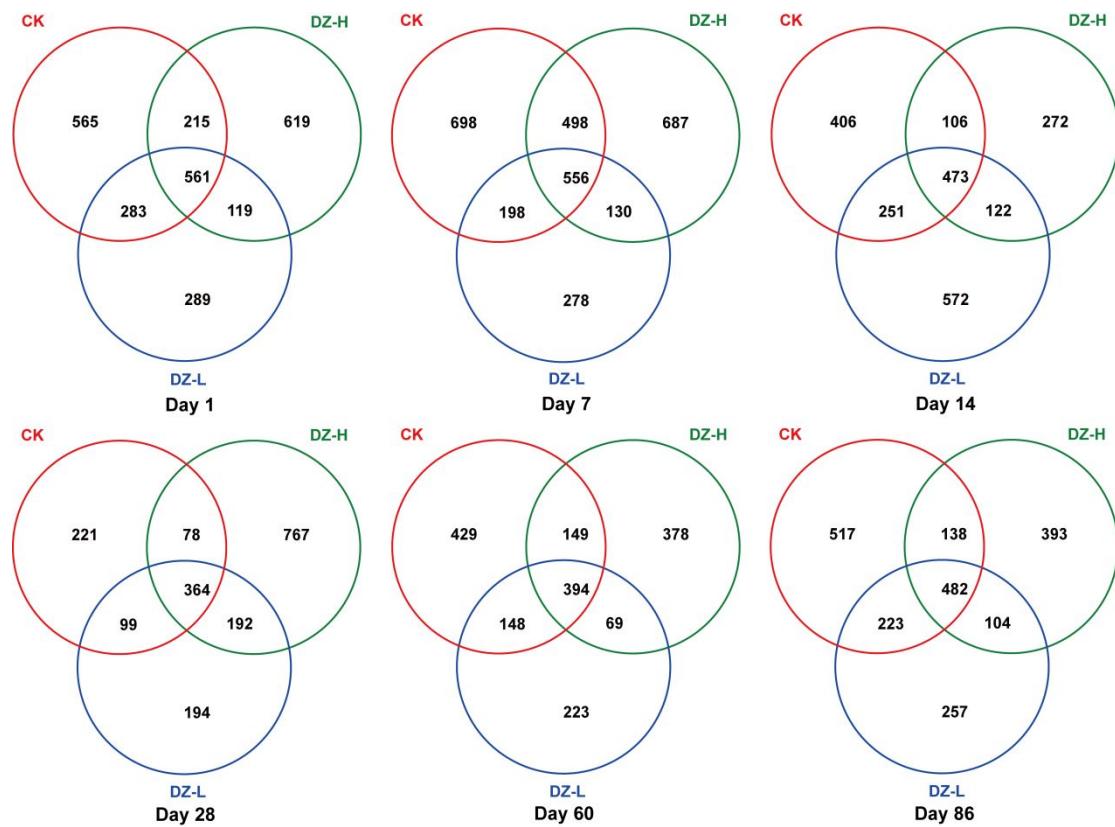


Fig. S1. Venn diagrams of *phoD*-harboring microbes after dazomet fumigation showing the extent of shared and unique Operational Taxonomic Units (OTUs) in the different treatments. CK= control; DZ-L= dazomet with Low dose; DZ-H= dazomet with High dose.

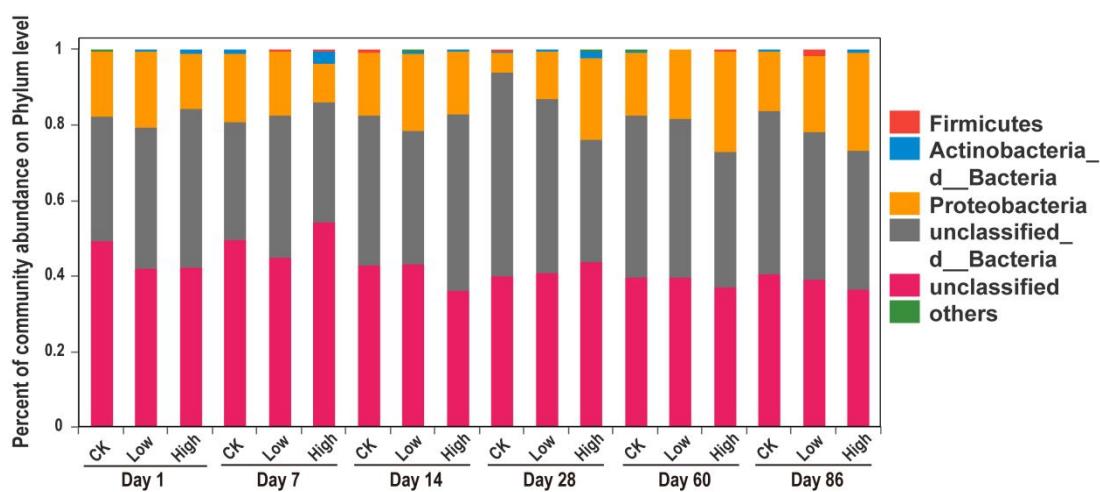


Fig. S2. Relative abundances in Phyla of soil *phoD*-harboring microbes 1, 7, 14, 28, 60 and 86 days after fumigation. CK= control; DZ-L= dazomet with Low dose; DZ-H= dazomet with High dose.