

## **Supporting Information**

### **Combined Controlled-Release and Common Fertilizer Application Increases Apple Productivity by Optimizing Soil Nutrient and Microbial Communities**

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**Table S1** Listed information was investigated genes and nucleotide sequences of developed primers

Target gene	Primer	Sequence (5'-3')
narG	narG-F	TACGGYTGGGGYATCGTTTGG
	NarG-R	TTCGCSGCRTGCACGTT
nasA	nasA-F	CAYTGGACVAAYGTSAARGCNGG
	nasA-R	GCCATGTCCTTSAGSACCAGRTG
nirS2	nirS2-F	CGCTSTGTTCTCGACAGY
	nirS2-R	ACRTTGTTSGCSGCRTACAT
nirK1	nirK1-F	GGMATGGTKCCSTGCRAA
	nirK1-R	GCRTASAKRTTDGTCGTT
UreC	UreC-F	ATGGTGCTYTGYYTGGYGC
	UreC-R	CTCATSGTYTCRTCCATRTC
nosZ1	nosZ1-F	WCSGGYTGSGGRTTSM TSGG
	nosZ1-R	GCGTCGATTTTGTYAGYTTG
hzsA	hzsA-F	ATCCTGGTTGAYTGGGTWTGG
	hzsA-R	GCTTTCGTTYTCCTTRTGC
amoA1	amoA1-F	GGGGTTTCTACTGGTGGT
	amoA1-R	CCCCTCKGSAAAGCCTTCTTC
amoB	amoB-F	AACATCGGCTTCTGGTTYGC
	amoB-R	GCRATGTCCTTSAGSACCAG
nxA	nxA-F	ATGCGYTGGAAGTGGAAYGC
	nxA-R	GCCATGTCCTTSAGSACCAG

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napA	napA-F	TAYTTYGAYCCVGAYATHGG
	napA-R	GCRTARTGRTRTRTGRTCYTG
nirS1	nirS1-F	CTTGTCGGCAGYGTSMTGG
	nirS1-R	AACGTCGTCRTRTCGTTGA
nirS3	nirS3-F	GTSAACGTSAAGGARACSGG
	nirS3-R	GASTTCGGRTGSGTCTTGA
nirK2	nirK2-F	CCGYCAYGGCAAGCTGATCC
	nirK2-R	GCCTCGATCAGRTTGTAGTT
gdh	gdh-F	ATGGCNGCNTTYGAYTTYGG
	gdh-R	TCRAANGCRTTYTTYTCYTC
nifH	nifH-F	TGCGAYCCSAARGCBGACTC
	nifH-R	ATSGCCATCATYTCRCCGGA
niK3	niK3-F	GGCTGCTYTGGAACGCG
	niK3-R	GGCGTTGAGCTTGTTGA
nosZ2	nosZ2-F	CGCRACGGCAASAAGGTSMSSGT
	nosZ2-R	CAKRTGCAKSGCRGTCGATT
hzo	hzo-F	TTCTGGGAYTTYGGYATGGG
	hzo-R	GCCATRTCRTTSAGSACCAG
hzsB	hzsB-F	ATCCTGGTTGAYTGGGTWTGG
	hzsB-R	GCTTTCGTTYTCCTTRTGC
amoA2	amoA2-F	GGGTHHTTCGGSTTCGTCCTG
	amoA2-R	CCCCTCKGSAAAGCCTTCTTC

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hao	hao-F	ATGGCCTTYTGGACYGAYGC
	hao-R	GCRATGTCCTTSAGSACCAG
cphy	cphy-F	TGGACCGYTGGTYGAGAAG
	cphy-R	GCCATRTCRTTSAGSACCAG
phnK	phnK-F	ATGGCCTTYTGGACYGAYGC
	phnK-R	GCRATGTCCTTSAGSACCAG
ppk3	ppk3-F	TAYGAYCCVGAYATHGGYT
	ppk3-R	GCRTARTGRTRTGRTCYTG
phoD	phoD-F	ACIGGIGGIGTIATGTCYCC
	phoD-R	GCSAKIGAKTTIGCRTGYTT
bpp	bpp-F	ATGGCCTTYTGGACYGAYGC
	bpp-R	GCRATGTCCTTSAGSACCAG
pqqC	pqqC-F	TAYGAYCCVGAYATHGGYT
	pqqC-R	GCRTARTGRTRTGRTCYTG
ppx	ppx-F	ATGGCCTTYTGGACYGAYGC
	ppx-R	GCRATGTCCTTSAGSACCAG
phoX	phoX-F	GAYTTYGAYCCVGAYATHGG
	phoX-R	GCRTARTGRTRTGRTCYTG

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**Figure S1** Release rate of nitrogen, phosphorus, potassium from controlled release fertilizer in laboratory water.

