Utilizing the mechanisms of *Nicotiana benthamiana* asparagine synthetase NbAS-B for the creation of PGANPs: A novel approach to enhance growth and induce resistance against viral infection

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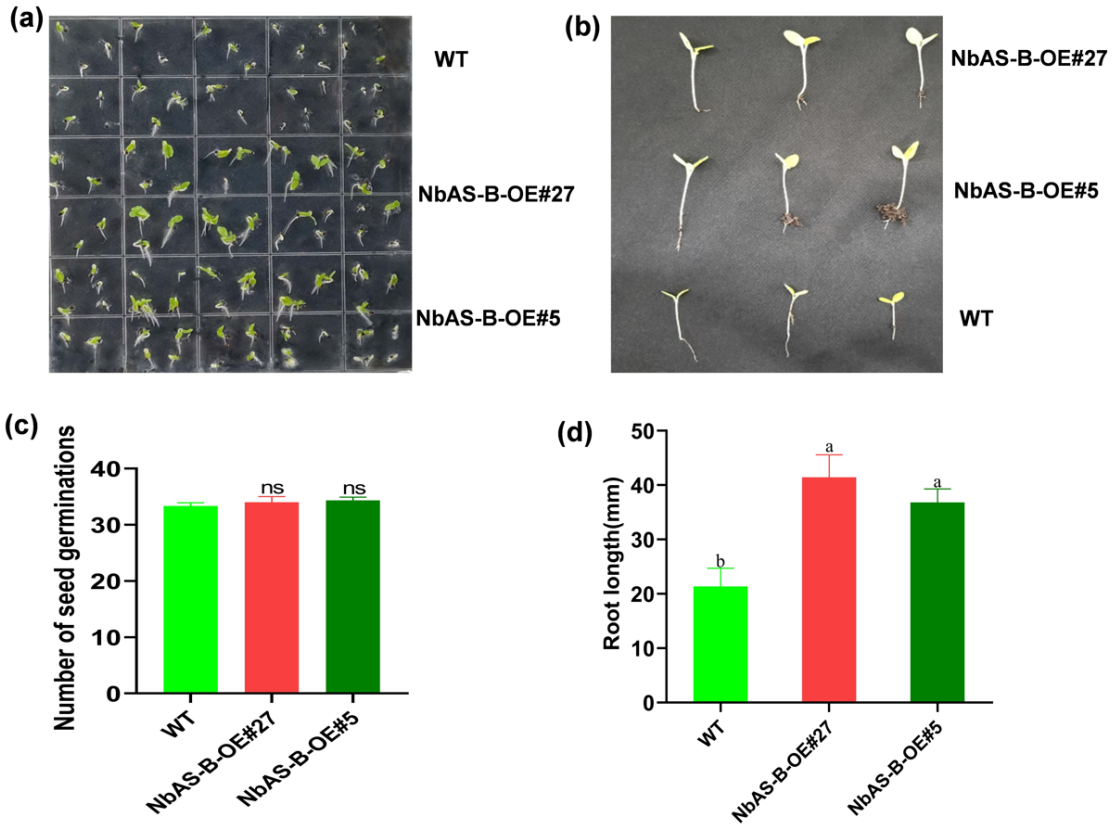

Figure S1 Figure of Seed Germination in NbAS-B Transgenic Plant Seeds (a) *NbAS-B* transgenic plant seed germination diagram, with 35 seeds each for *NbAS-B* transgenic plants and WT plants. (b) *NbAS-B* transgenic plant seedling growth chart. (c) Statistics of seed germination numbers for *NbAS-B* transgenic plants and WT. (d) root length of *NbAS-B* transgenic plants and WT plants.

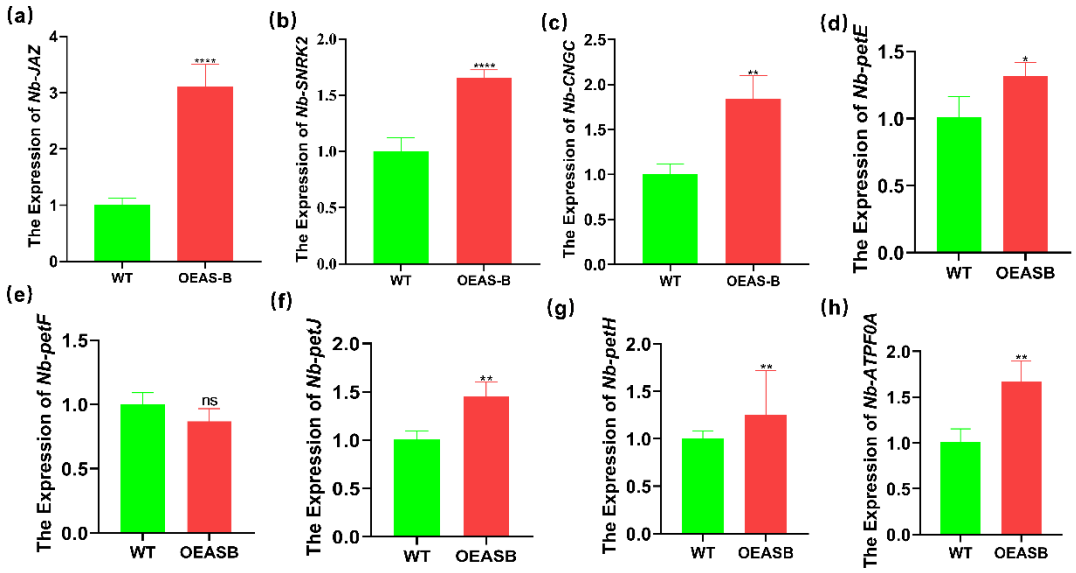

Fig. S2 (a) Validation of resistance genes *Nb-JAZ*, *Nb-SNRK2*, and *Nb-CNGC* in the

NbAS-B overexpression transcriptome. (d-h) Validation of genes related to the electron transport chain in the *NbAS-B* overexpression transcriptome.

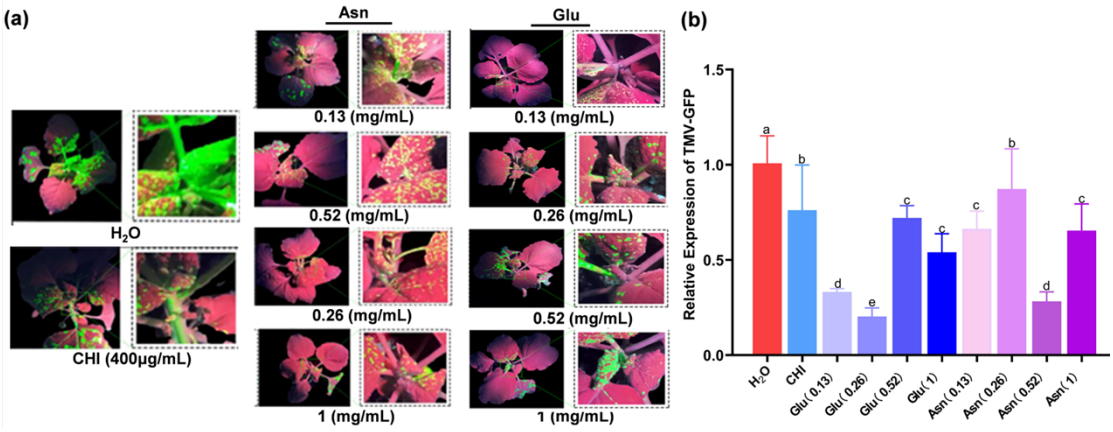

Fig. S3 The inductive effects of Glu and Asn on TMV-GFP. (a)Viral infection maps of leaves inoculated with TMV-GFP after being sprayed with different concentrations of Glu and Asn on the 7th day. (b)The effects of Glu and Asn on the transcriptional expression of TMV-GFP detected by qPCR.

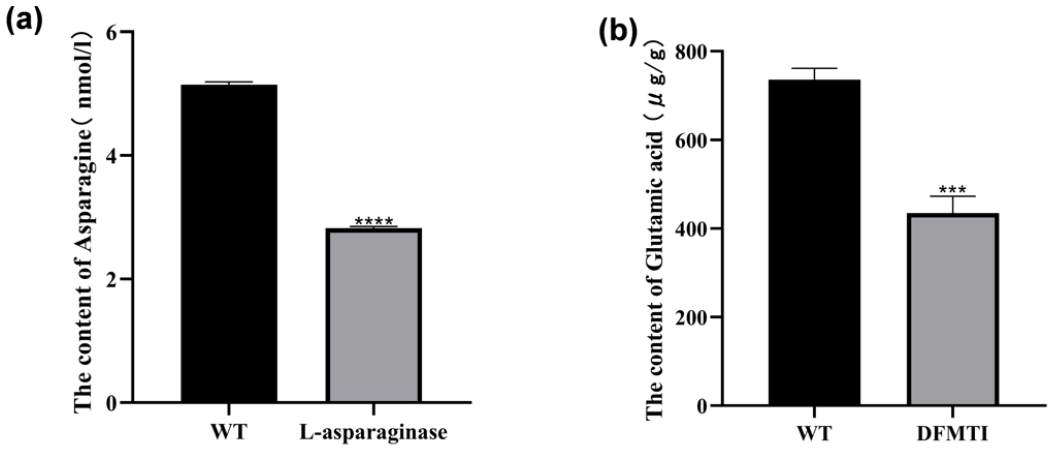

Fig. S4 (a-b) Detection of Asn and Glu content after treatment with inhibitors L-asparaginase and DFMTI.

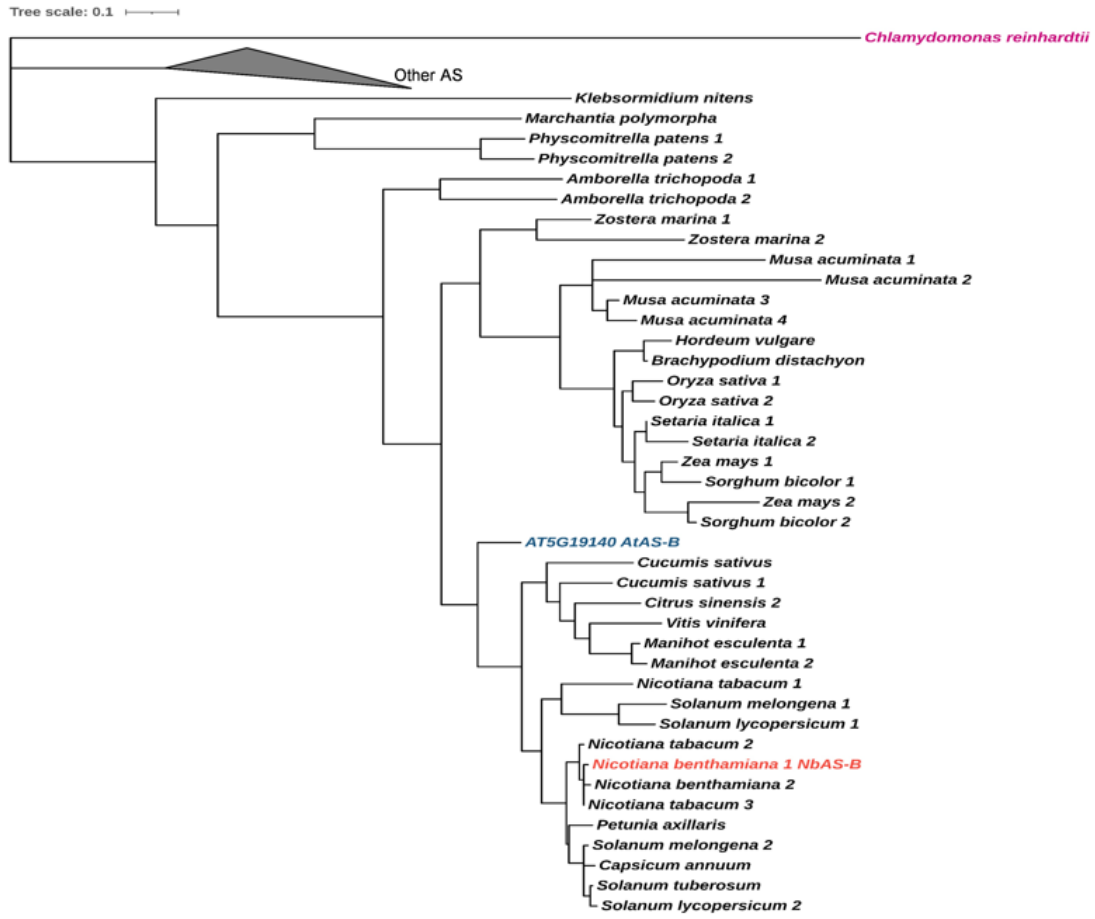

Fig. S5 Analysis of the evolutionary relationship of ASB in different species.

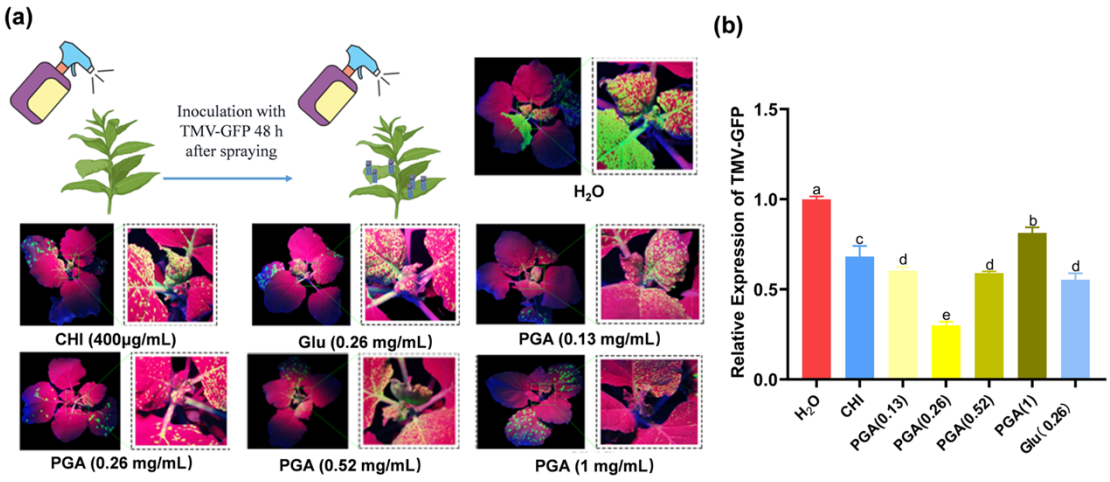

Fig. S6 (a) Foliar application of different concentrations of Glu and PGA followed by inoculation with TMV-GFP. (b) Virus expression levels in plants treated with PGA detected by qPCR.

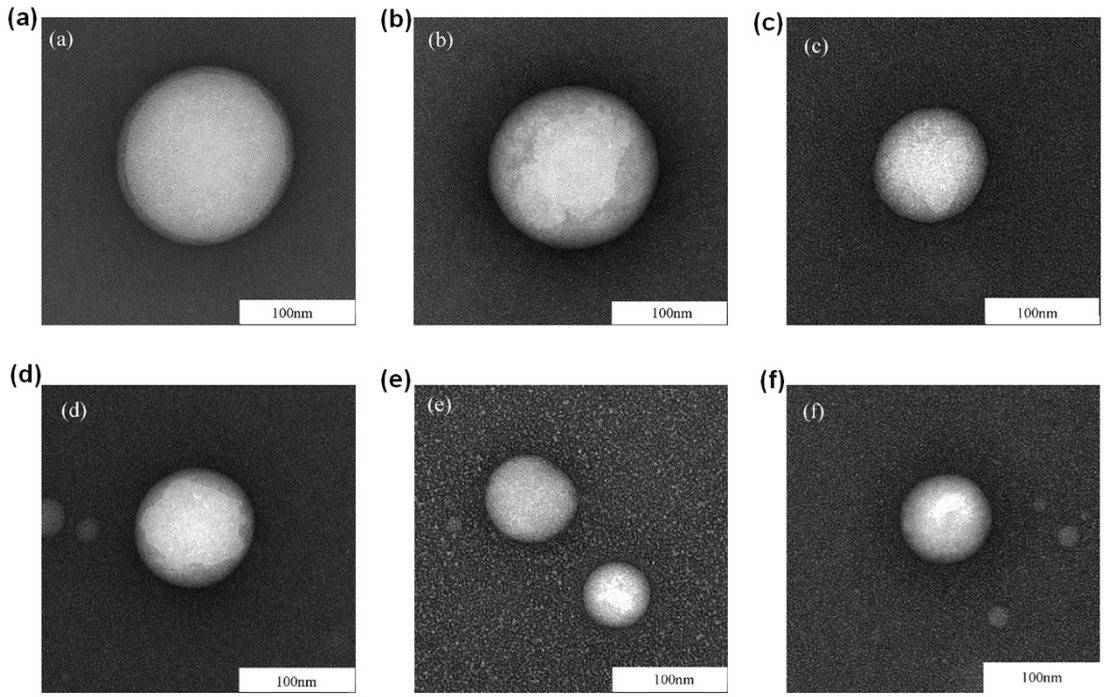

Fig. S7 (a-f) TEM images of PGANP. (a-f) represent different concentrations of PGANP.

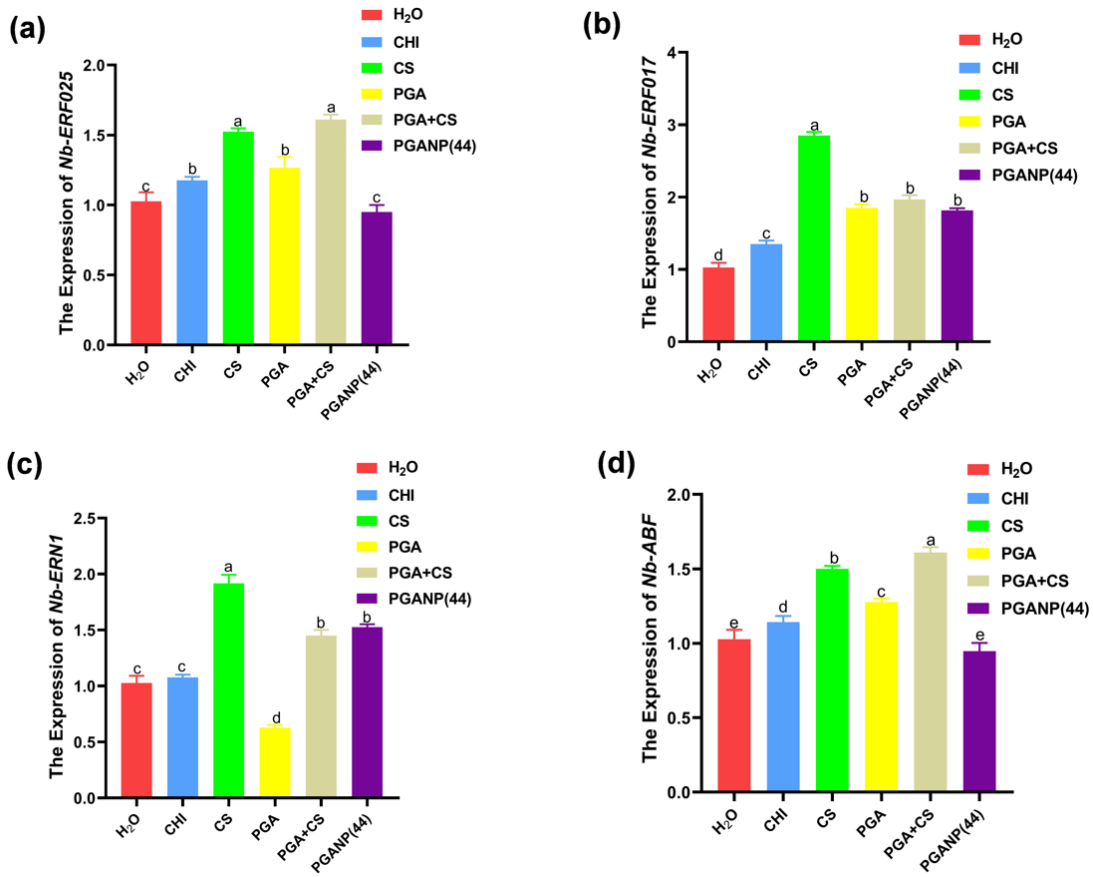

Fig. S8 Effect of PGANP on ABA and ET signaling pathways (a-b) Effects of PGANP

on the expression of ET hormone-related genes. (c-d) Effects of PGANP on the expression of ABA hormone-related genes

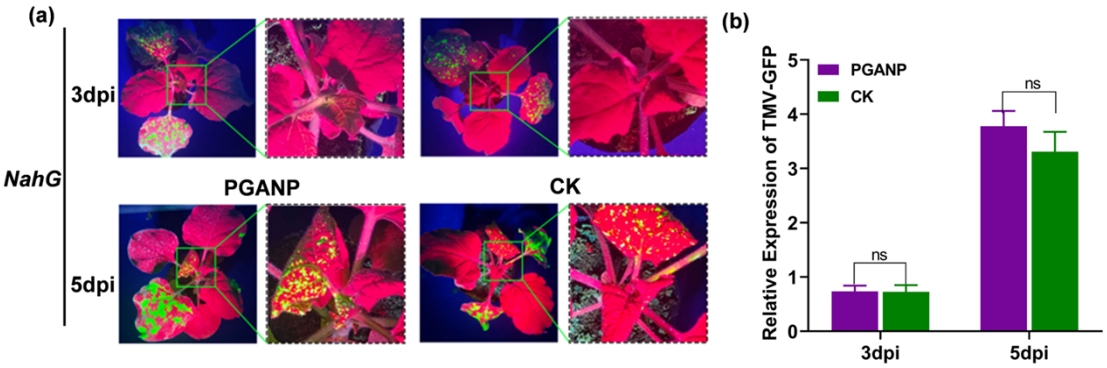

Fig. S9 (a) Symptom diagram of TMV-GFP inoculation after exogenous application of PGANP in *NahG* transgenic plants. (b) qPCR detection of the viral nucleic acid level on days 3 and 5 after inoculation with TMV-GFP following exogenous application of PGANP in *NahG*.

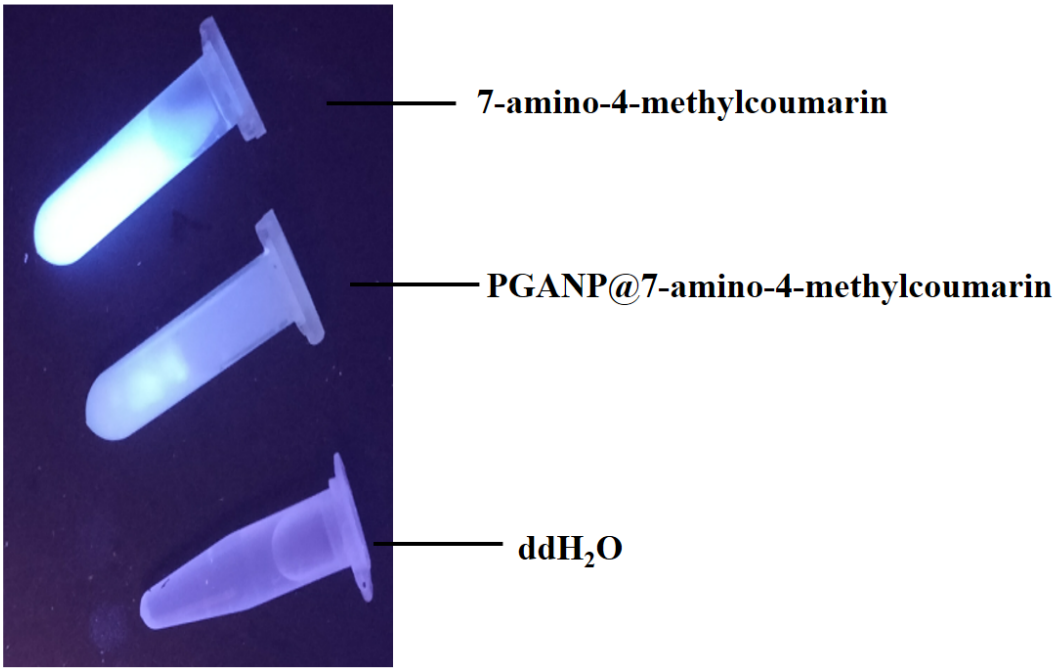

Fig. S10 Surface fluorescence of PGANP@7-amino-4-methylcoumarin material under the irradiation of a portable UV lamp.

Table S1 Primer sequence used in qPCR for amplifying target gene.

Primers name	Forward Primers sequence	Reverse Primers sequence
qNbAS-B	TTGCCAAGTCTGCAAATGAG	CACCTTTGAGCAAATCAGCA
qTMV CP	TTAGGTTCCCTGACGGTGAC	ACCGTTGCGTCGTCTACTCT
qACTIN	CTTGAAACAGCAAAGACCAGC	CATCCTATCAGCAATGCCCG
qPR1	CGTGAAGATGTGGGTCAATG	CCATACGGACGTTGTCCTCT
qICS1	GTGTCGGCTCTGCTGTCTTCT	CTGCGTATAGCACGCCAATC
qPAL2	TTGCTTAAGGTTGTTGATCGTG	GATCGAAGTCACTGCATTCTTC
qERF025	GCAAAGCAAAACTCAATTTCCC	TTCGGTATACTTTGTGGTTCCA
qERN1	CCTTGTCACTAATGGAGCAGG	CACGATGAAGCCAAGCG
qERF017	GCACACGACGTTGCTTTCTTC	GTCGTCGTATCTCCGCATCC
qABF	ATTATCGGACACACAAACACTCG	TTGTTCTCCAGTTCATGGGTGTA
qpetH	AGAGGCTTGTAGGCCCAAAT	GACAGCTCGCCTGATACACA
qpetE	CAAAAGCAAGACTGCCATCA	TGTAGCCAAAATGGTGTCCA
qpetF	TGGCAGTGTACAGGGTGAAA	CCCTCGGATTGGTCTACTGA
qpetJ	GAGCTGACACGGAAGAGGAG	TTTTAGGCCAACCTTGATCG
qATPF0A	CCCCAATCCTTTTACCCATT	AATCCAAGGAGCATGACAGG

Table S2 Elementary organic analysia of PGANP

Sample	Weight/mg	N%	C%	H%
PGANP (6.28)	1.915	2.06	31.18	5.109
PGANP(14.14)	2.144	1.77	66.01	10.553
PGANP (22)	1.976	2.7	32.58	5.43
PGANP (33)	2.124	3.58	34.04	5.702
PGANP (44)	2.081	2.17	32.32	5.661
PGANP (62.8)	1.835	3.43	38.24	6.238
CS	2.301	7.97	39.96	6.336
PGA	2.216	8.1	33.01	4.611