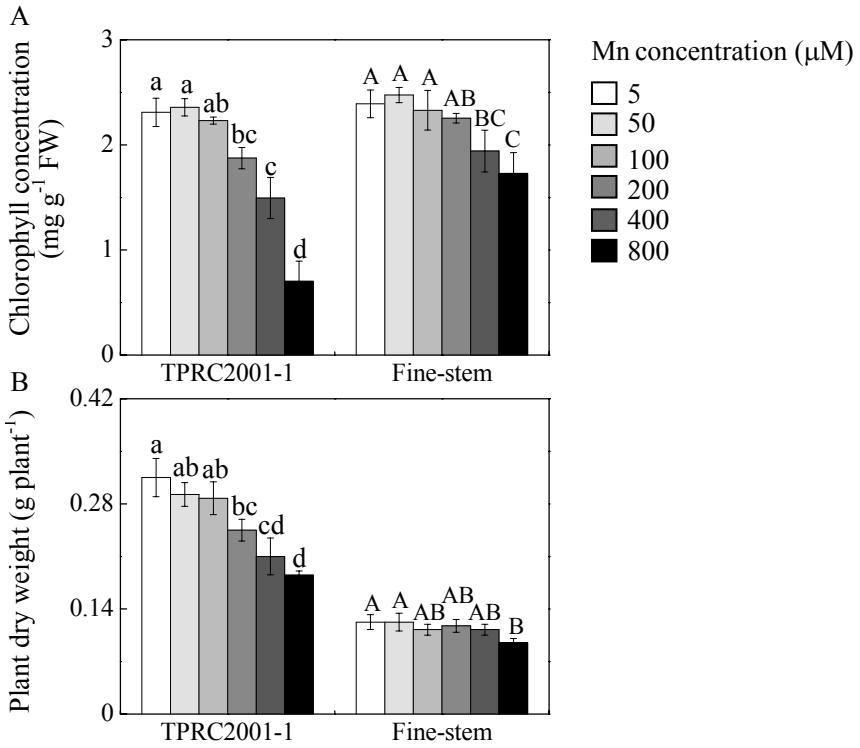
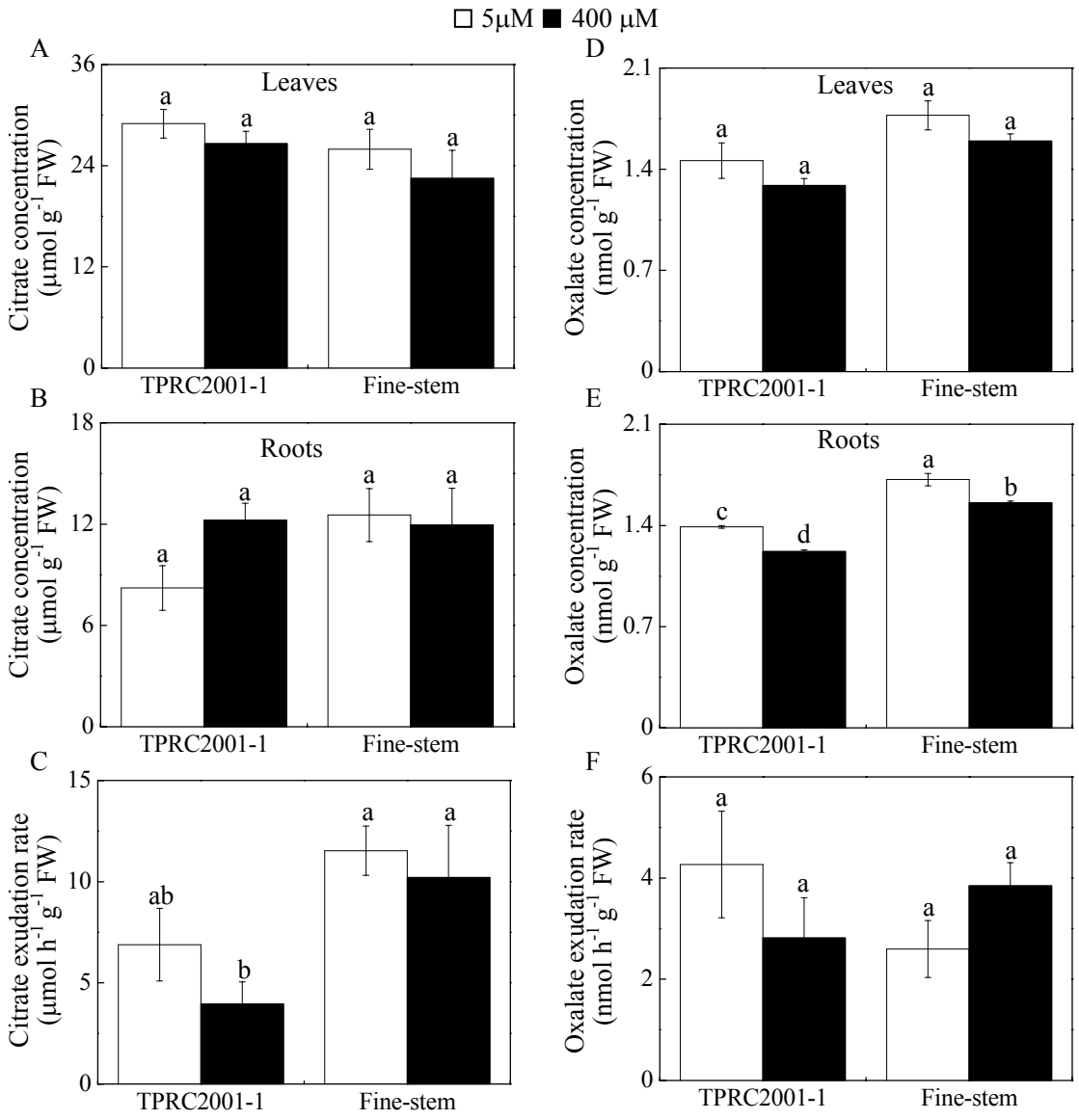
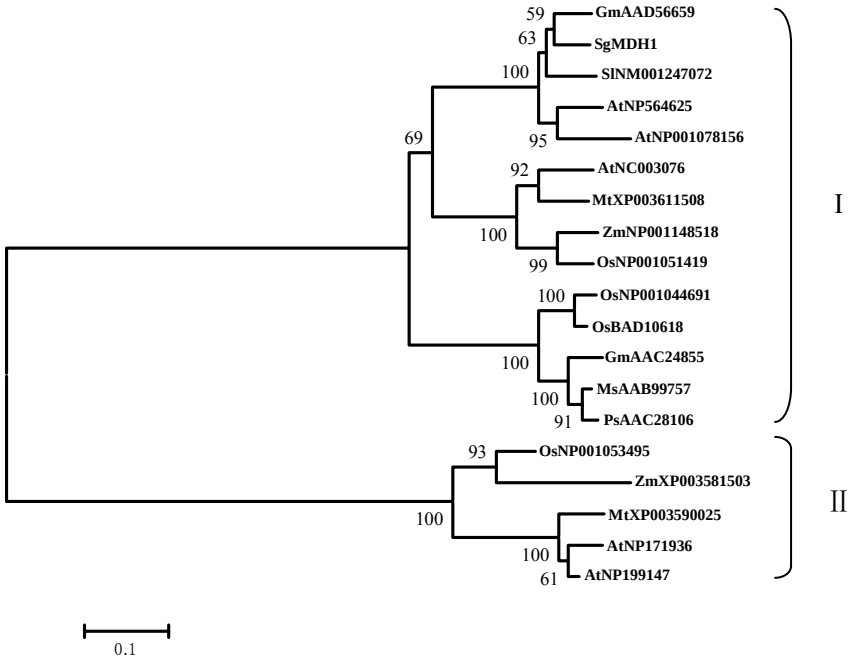


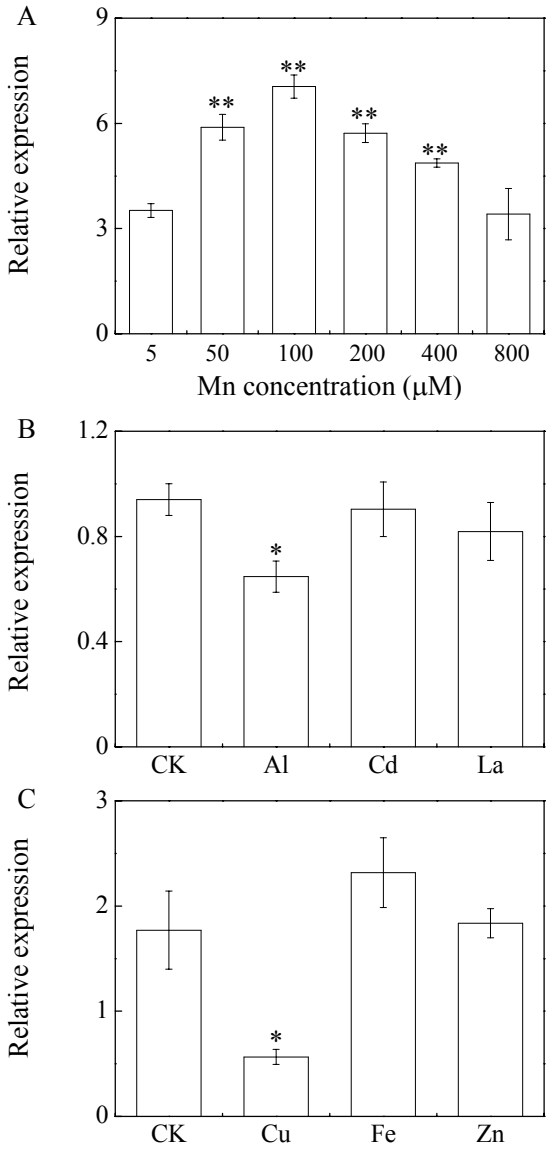
Supplemental Figure S1. Growth and chlorophyll concentrations of two stylo genotypes at different Mn levels. A, Leaf chlorophyll concentrations; B, Plant dry weight. Stylo seedlings were grown under normal conditions for 1 month, and then treated with 5 to 800 μM $MnSO_4$ for 10 d. Each bar represents the mean of four independent replicates with standard error. Different lower and upper letters mean a significant difference among Mn treatments at the P=0.05 level within the same stylo genotype.



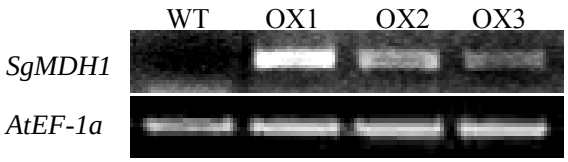
Supplemental Figure S2. Internal and secreted citrate and oxalate in two stylo genotypes grown at two Mn treatments. A and B, Citrate concentrations in leaves (A) and roots (B); C, Citrate exudation rate from roots; D and E, Oxalate concentrations in leaves (D) and roots (E); F, Oxalate exudation rate from roots. Stylo seedlings were separately treated with 5 or 400 μM $MnSO_4$. After 10 d, seedlings were transplanted into 40 mL fresh nutrient solution to collect root exudates for 6 h. Each bar represents the mean of four independent replicates with standard error. Different letters mean a significant difference at the P=0.05 level.



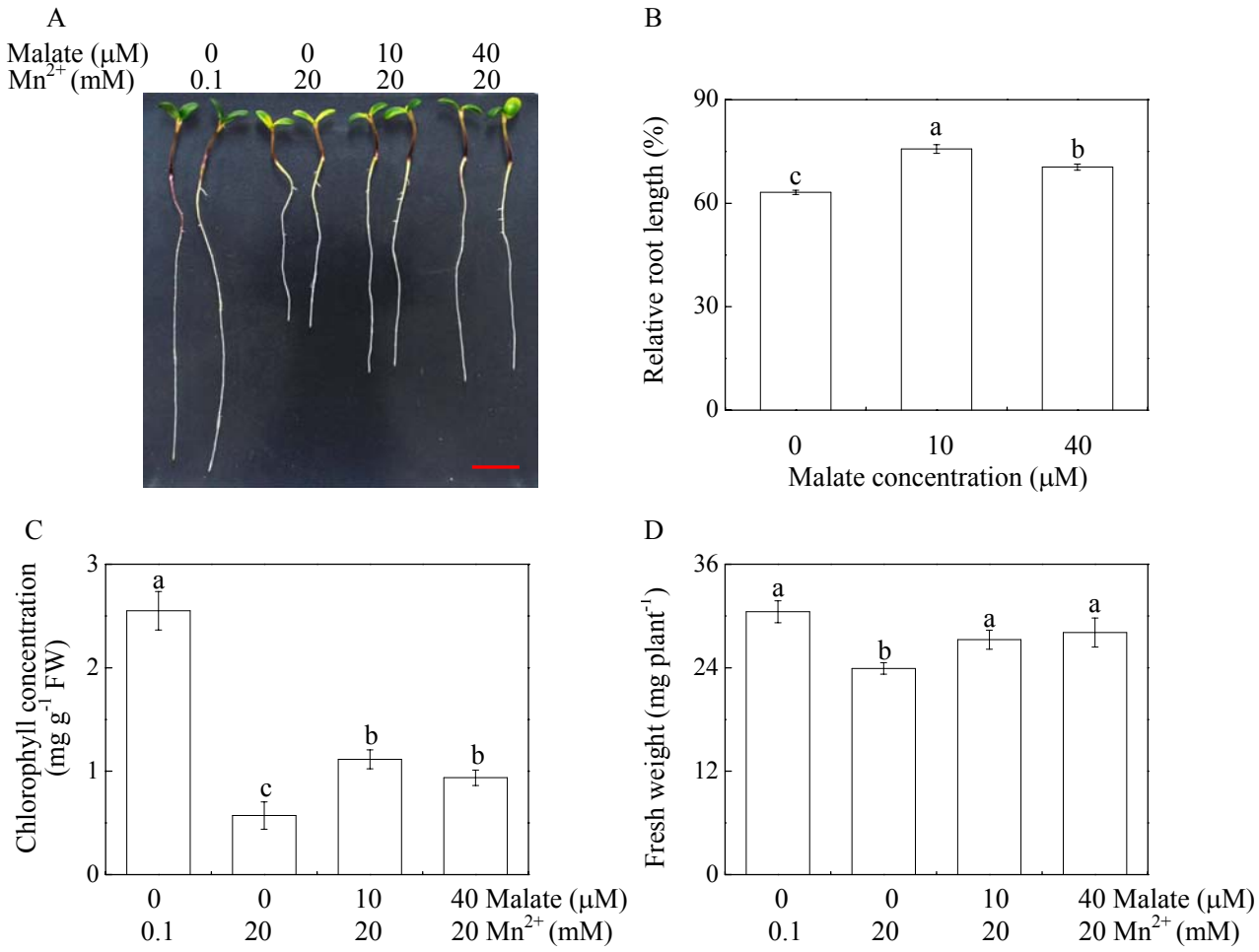
Supplemental Figure S3. Phylogenetic analysis of SgMDH1 with other plant MDHs. The phylogenetic tree was constructed using the MEGA 4.1 program. The first two letters of each protein label represent the abbreviated species name, followed by a GenBank accession number. Sg, *Stylosanthes guianensis*; At, *Arabidopsis thaliana*; Os, *Oryza sativa*; Ps, *Pisum sativum*; Gm, *Glycine max*; Zm, *Zea mays*; Mt, *Medicago truncatula*; Ms, *Medicago sativa*; Sl, *Solanum lycopersicum*.



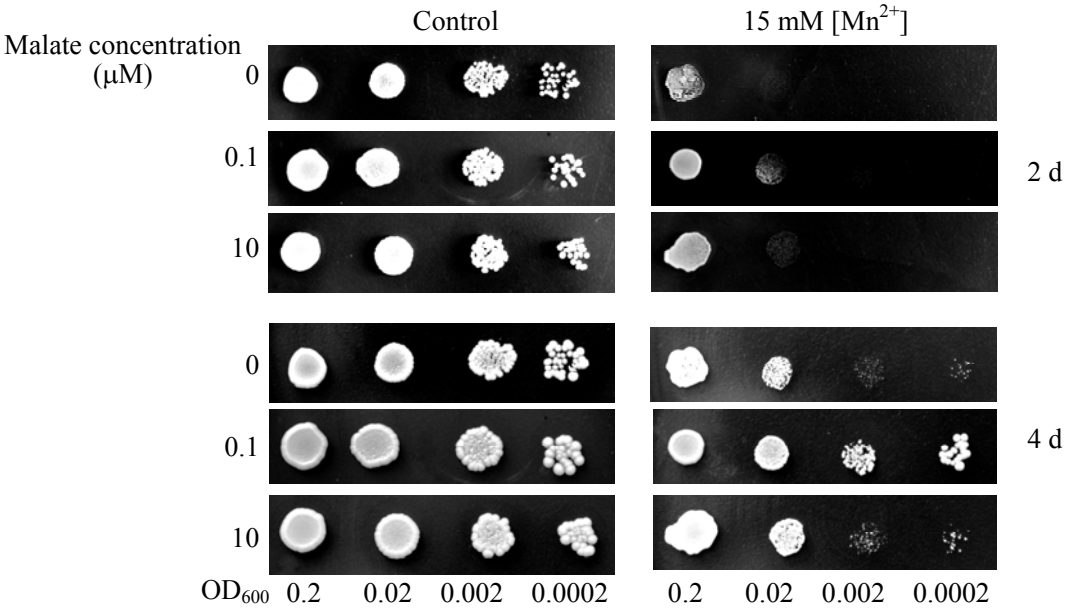
Supplemental Figure S4. Expression pattern of *SgMDH1* in stylo subjected to toxicity of Mn and other metal ions. A, Effects of different Mn concentrations on *SgMDH1* expression; B, Expression of *SgMDH1* response to Al, Cd and La. C, Expression of *SgMDH1* response to Cu, Fe and Zn. Stylo seedlings were grown under normal conditions for 1 month, and then the seedlings were separately treated with 5 to 800 μM $MnSO_4$ for 10 d (A), or exposed to a 0.5 mM $CaCl_2$ solution containing 0, 100 μM Al^{3+}, 40 μM Cd^{2+}, or 20 μM La^{3+} at pH 4.5 for 1 d (B), or treated with 10 μM Cu^{2+}, 800 μM Fe^{2+} and 20 μM Zn^{2+} for 5 d (C). Each bar represents the mean of three independent replicates with standard error. Asterisks indicate significant differences between the different metal treatments and the control at the P=0.05 level. *: 0.01<P<0.05; **: 0.001<P<0.01.



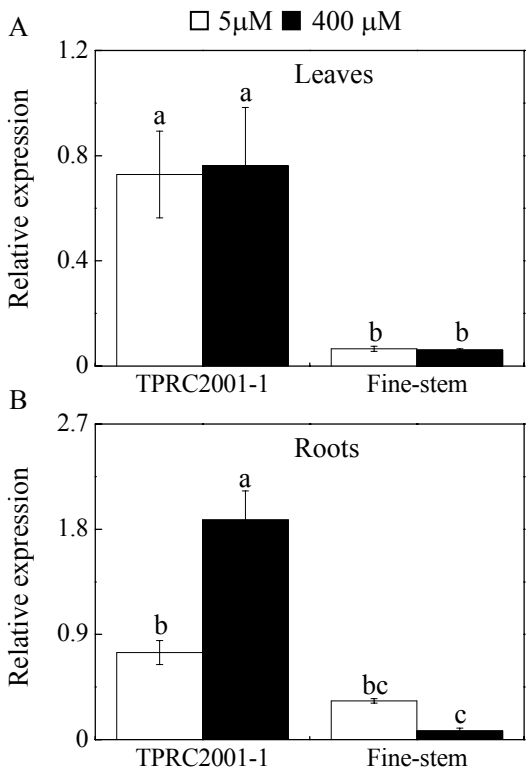
Supplemental Figure S5. Expression analysis of *SgMDH1* in transgenic Arabidopsis. Semi-quantitative PCR was performed to examine *SgMDH1* expression in Arabidopsis.



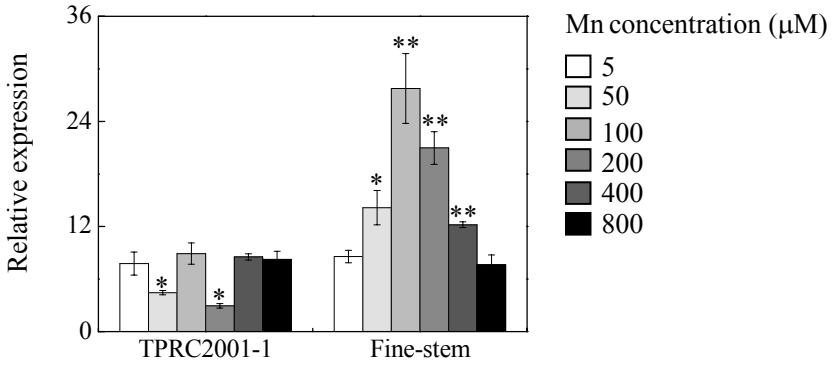
Supplemental Figure S6. Effects of exogenous malate on the growth of TPRC2001-1 under excess Mn conditions. A, Growth performance of stylo seedlings; B, Relative root length; C, Chlorophyll concentrations; D, Fresh weight. After germination for 2 d, TPRC2001-1 seedlings were exposed to 0.1 or 20 mM $MnSO_4$ treatments on the MS solid culture medium containing 0, 10, or 40 μM malate at pH 5.0 for 4 d. Each bar represents the mean of three independent replicates with standard error. Different letters mean a significant difference at the P=0.05 level. Bar=1 cm.



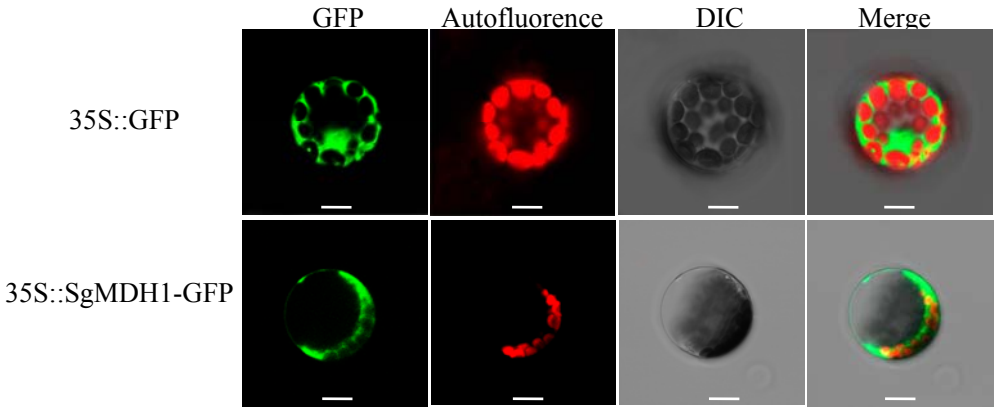
Supplemental Figure S7. Growth of yeast cells under excess Mn conditions supplied with malate. Yeast cells (INVSC1) with different OD_{600nm} of 0.2 and four gradient 1:10 dilutions were spotted on SC medium containing different malate concentrations with or without 15 mM $MnSO_4$ application (pH 5.0) at 30℃ for 2 and 4 d.



Supplemental Figure S8. Expression analysis of *SgMTP1* in two stylo genotypes at two Mn levels. A, *SgMTP1* expression in leaves; B, *SgMTP1* expression in roots. Stylo seedlings were grown under normal conditions for 1 month, and then treated with 5 or 400 μM $MnSO_4$ for 10 d. Each bar represents the mean of three replicates with standard error. Different letters mean a significant difference at the *P*=0.05 level.



Supplemental Figure S9. Expression of *SgALMT1* responsive to different Mn concentrations. Stylo seedlings were grown under normal conditions for 1 month, and then the seedlings were separately treated with 5 to 800 μM $MnSO_4$ for 10 d. Each bar represents the mean of three replicates with standard error. Asterisks indicate significant differences between excess Mn treatments and its control. *: $0.01<P<0.05$; **: $0.001<P<0.01$.



Supplemental Figure S10. Subcellular localization of SgMDH1 in Arabidopsis mesophyll protoplasts. Scale bar is 10 μm.

Supplemental Table I. List of primers used in the study for functional analysis of *SgMDH1*, expression analysis of *SgMTP1* and *SgALMT1*.

Primer name	Sequence (5'- 3')
SgMDH1-EST-F	ATTATTGCCGCTGAGGTTTTCAAGA
SgMDH1-EST-R	GATTCCCTTCAAGCAAGCATCG
SgMDH1- 5'RACE -F	GAAAACCTCAGCAGCAATGGGAACAGT
SgMDH1-3'RACE -R	CTGCTGAGGTTTTCAAGAAGGCAGG
SgMDH1-GST-F	GGATCCATGATTAAGCCTTCGATGC
SgMDH1-GST-R	GAATTCTTACTGGTTGGCGAATT
SgMDH1-OX-F	GGATCCAATGATTAAGCCTTCGATGC
SgMDH1-OX-R	ACGCGTTTACTGGTTGGCGAATT
SgMDH1-pYES2-F	CGGGATCCAAAAAAATGTCTATTAAGCCTTCGATGCTC
SgMDH1-pYES2-R	GAATTCTTACTGGTTGGCGAATTTG
SgMDH1-RT-F	CCGCTGAGGTTTTCAAGAAGGCAGG
SgMDH1-RT-R	CCTGCATGGCCACCTATGACCG
SgMDH1-GFP-F	TCTAGAGATGATTAAGCCTTCG
SgMDH1-GFP-R	GGATCCCGCTGGTTGGCG
SgMTP1-RT-F	GCAGTCGAGATTTCTGGCTGGTGG
SgMTP1-RT-R	TCTCCCAACTGGCTGCACCCT
SgALMT1-RT-F	GGTGGAAGATGGCGAAGCAGGTG
SgALMT1-RT-R	TGAGAATGGCCCAAACGGAGTAGC
SgEF-1a-F	CACTTCAGGACGTGTACAAGATC
SgEF-1a-R	CTTGGAGAGCTTCATGGTGCA
AtEF-1a-F	GTCGATTCTGGAAAGTCGACC
AtEF-1a-R	AATGTCAATGGTGATACCACGC
UPM	CTAATACGACTCACTATAGGGCAAGCAGTGGTATCAACGCAGAGT