Supplementary Video 1. Nitrate stimulates dynamic Ca^{2+} increase in mesophyll protoplasts expressing GCaMP6. Mesophyll protoplasts expressing GCaMP6 were treated with 10 mM KNO_3. The time-lapse video shows the representative GFP fluorescence signal changes in response to nitrate treatment using the Leica DM5000B microscope. The images are representative of 10 protoplasts. The images were acquired every two sec for 6 min and then made into a stack and converted to a video (7 frames/sec, 1 sec in the video equals to 12 sec in the recording).

Supplementary Video 2. Nitrate stimulates dynamic Ca^{2+} increase in transgenic cotyledons expressing GCaMP6. The cotyledon of a GCaMP6 transgenic seedling was treated with 10 mM KNO_3. The time-lapse video shows the representative GFP fluorescence signal changes in response to nitrate treatment using the Leica TCS NT SP1confocal microscope. The images are representative of 10 seedlings. The images were acquired every 10 sec for 8 min and then made into a stack and converted to a video (7 frames/sec, 1 sec in the video equals to 1 min in the recording).

Supplementary Video 3. Nitrate stimulates dynamic Ca^{2+} increase in the transgenic root tip expressing GCaMP6. The root tip of a GCaMP6 transgenic seedling was treated with 10 mM KNO_3. The time-lapse video shows the representative GFP fluorescence signal changes in response to nitrate treatment using the Leica TCS NT SP1confocal microscope. The images are representative of 10 seedlings. The images were acquired every 10 sec for 5 min and then made into a stack and converted to a video (7 frames/sec, 1 sec in the video equals to 1 minute in the recording).

Supplementary Video 4. Nitrate stimulates dynamic Ca^{2+} increase in the transgenic root elongated region expressing GCaMP6. The root elongated region of a GCaMP6 transgenic seedling was treated with 10 mM KNO_3. The time-lapse video shows the representative GFP fluorescence signal changes in response to nitrate treatment using the Leica TCS NT SP1 confocal microscope. The images are representative of 10 seedlings. The images were acquired every 10 sec for 5 min and then made into a stack and converted to a video (7 frames/sec, 1 sec in the video equals to 1 minute in the recording).

Source Data

Figure 1h

	KCl			KNO_3		
Ctl	1.0	1.0	1.5	4.6	4.6	3.6
CPK1	2.2	1.7	1.3	8.8	4.7	3.7
CPK2	1.2	2.2	0.9	3.4	4.9	2.5
CPK3	1.7	1.8	1.7	5.4	6.8	5.9
CPK4	1.2	1.2	1.5	8.5	7.2	6.8
CPK5	1.8	1.1	1.4	6.6	8.6	7.8
CPK6	3.0	1.3	1.4	8.4	7.7	8.1
CPK7	1.7	1.3	2.0	8.6	13.6	9.4
CPK8	1.6	2.4	1.9	11.3	12.2	15.5
CPK9	1.0	1.0	0.8	5.8	4.4	4.7
CPK10	1.6	2.0	2.0	19.1	10.9	13.0
CPK11	1.6	1.1	1.8	6.6	5.5	7.9
CPK12	0.9	1.9	0.8	7.3	4.9	4.8
CPK13	1.7	1.8	2.2	8.0	15.8	10.6
CPK15	0.5	1.1	1.9	3.9	3.0	5.4
CPK21	1.7	0.9	0.7	6.4	6.1	4.2
CPK22	0.8	1.2	0.5	6.7	5.7	3.9
CPK23	1.4	2.0	0.6	8.6	6.3	8.4
CPK26	1.4	2.3	1.7	5.0	3.1	4.8
CPK27	0.6	0.5	1.3	4.5	1.7	4.9
CPK28	0.8	0.9	1.6	2.9	2.7	5.7
CPK29	0.8	1.4	0.4	4.0	2.4	2.5
CPK30	1.1	1.1	1.1	13.2	10.8	12.4
CPK31	0.4	1.1	0.4	3.8	2.5	3.6
CPK32	1.0	1.9	1.6	28.0	24.3	29.5
CPK33	0.9	1.3	0.9	2.6	2.7	3.8

Figure 2g

	NIR			*G6PD3*			*FNR2*		
WT K	1.2	1.0	0.8	0.9	1.1	1.0	0.9	1.1	1.0
WT N	12.3	13.1	10.9	5.3	5.0	3.8	3.4	3.8	3.3
icpk K	1.1	0.8	0.9	1.2	0.8	0.9	0.7	0.8	0.7
icpk N	4.9	5.1	4.5	1.7	1.9	2.0	1.3	1.5	1.3

Extended Fig. 1d

	NRT1.1			*LHCB2.2*			*UBQ10*		
Root	9471	10310.0		128.0	131.0		10157.0	11560.0	
Shoot	8847	7252.0		12841.0	11238.0		10876.0	10402.0	
Mesophyll Protoplasts	27202.9	26957.0	29725.8	13576.6	24899.5	25401.3	34083.4	35318.6	39706.3

Extended Fig. 1e

	KCl			KNO_3		
Seedling	1.1	1.1	0.8	20.1	16.7	18.4
Mesophyll Protoplasts	1.0	0.9	1.1	14.5	10.8	10.6

Extended Fig. 2a

	Ctl K			Ctl N			$GdCl_3$ K			$GdCl_3$ N		
NIR	1.0	1.4	0.6	7.6	6.7	7.5	0.5	0.6	0.5	3.5	3.4	3.2
G6PD3	1.0	1.1	0.9	5.4	4.9	5.4	0.7	0.6	0.7	2.3	2.1	1.9
FNR2	1.1	1.1	0.8	3.1	2.8	2.9	0.6	0.7	0.8	1.5	1.3	1.3
	$LaCl_3$ K			$LaCl_3$ N								
NIR	0.8	1.0	1.0	2.5	3.1	2.6						
G6PD3	0.7	0.7	0.8	1.8	2.8	2.2						
FNR2	0.7	0.8	0.7	1.1	1.6	1.6						

Extended Fig. 2b

	W5 K			W5 N			W7 K			W7 N		
NIR	1.1	1.1	0.8	6.5	6.4	5.7	0.6	0.3	0.3	2.6	2.7	2.5
G6PD3	0.9	1.3	0.7	7.1	4.9	6.4	0.0	0.8	0.8	3.0	2.4	2.3
FNR2	1.1	1.2	0.8	2.6	2.7	4.2	1.1	0.8	0.7	1.5	1.5	1.0

Extended Fig. 2d

	Sample		
0.5	1.3	1.3	1.2
1	1.2	1.1	1.1
2	3.3	3.1	2.7
3	2.1	2.4	3.0

Extended Fig. 2e

	Sample		
KCl	1.2	1.3	0.2
NH_4^+	2.0	1.6	0.8
Gln	0.7	1.3	0.6
KNO_3	3.3	6.2	3.9

Extended Fig. 2f

	KCl			KNO_3		
0.1	1.1	1.0	0.8	1.5	2.1	1.6
0.5	1.6	1.3	0.7	6.4	2.6	3.1
1	0.8	0.6	0.6	5.3	5.8	9.8
5	0.6	0.5	0.9	8.6	8.4	11.0
10	1.4	0.8	1.2	9.4	11.0	10.4
50	0.4	0.4	0.5	11.6	8.4	5.7

Extended Fig. 3d

	W K			W N			*CPK7* K			*CPK7* N		
NIR	0.9	1.0	1.1	8.0	8.6	8.9	1.1	1.4	1.1	8.9	11.1	9.1
G6PD3	1.2	0.8	1.0	6.0	6.3	7.1	0.9	0.9	1.2	7.8	7.2	5.8
	CPK13 K			*CPK13* N			*CPK30* K			*CPK30* N		
NIR	1.2	1.0	1.3	7.1	7.7	7.5	1.0	1.3	1.1	6.2	4.1	7.4
G6PD3	0.9	0.9	1.0	5.4	5.8	5.9	0.9	1.0	0.9	5.3	2.7	5.4
	CPK8 K			*CPK8* N			*CPK10* K			*CPK 10* N		
NIR	1.1	0.9	1.4	10.0	10.1	8.4	1.0	1.1	1.2	7.6	9.2	7.8
G6PD3	0.9	1.1	1.3	8.0	8.0	5.6	0.8	1.1	1.0	5.2	6.7	5.6
	CPK 32 K			*CPK 32* N								
NIR	0.9	0.8	0.8	7.7	6.1	7.9						
G6PD3	1.1	1.1	0.9	6.2	5.0	6.2						

Extended Fig. 3i

	WT K			WT N			*cpk10,32 K*			*cpk 10,32 N*		
NIR	1.3	0.8	0.9	9.7	9.0	9.2	0.0	0.7	0.5	6.9	4.8	3.5
G6PD3	1.1	0.9	1.0	6.4	5.0	5.4	0.2	0.7	0.7	4.4	3.6	3.8
FNR2	1.1	1.0	0.9	3.4	3.9	3.4	0.1	1.0	0.7	1.8	1.7	2.2
	cpk30,32 K			*cpk30,32 N*								
NIR	0.9	0.8	0.8	5.9	6.1	7.4						
G6PD3	1.1	1.0	1.0	5.9	4.6	4.8						
FNR2	0.5	0.8	0.8	3.3	2.1	2.4						

Extended Fig. 3j

	NIR			*G6PD3*			*FNR2*		
WT K	1.2	1.0	0.8	0.9	1.1	1.0	0.9	1.1	1.0
WT N	12.3	13.1	10.9	5.3	5.0	3.8	3.4	3.8	3.3
cpk10, 30 K	0.8	0.9	0.7	0.6	0.7	0.7	0.7	0.8	0.7
cpk 10, 30 N	8.7	8.0	6.5	3.7	2.5	2.7	2.5	1.6	2.4

Original gels/blots