Table S1 Physical and chemical properties of volcanic ash

Test items	Test results	Unit
Calcium (Ca)	0.46	%
Calcium oxide (CaO)	0.64	%
Magnesium (Mg)	0.18	%
Magnesium oxide (MgO)	0.30	%
Silicon (Si)	0.43	%
Silicon dioxide (SiO_2)	0.92	%
pH (1:250)	7.34	/
Water (H_2O)	0.22	%
Sulfur (S)	0.01	%
Chloride ion (Cl^-)	<0.000057	%
Natrium (Na)	0.01	%
Arsenic (As)	0.3	mg/kg
Lead (Pb)	<15	mg/kg
Cadmium (Cd)	<1.5	mg/kg
Chromium (Cr)	84.1	mg/kg
Hydrargyrum (Hg)	<0.0039	mg/kg

Table S2 Chemical analysis table for salt-alkali soil

Depth of excavation (cm)	pH	Soluble salt (%)									Substitution		Organic matter (%)
		Full salt	Cl^-	SO_4^{2-}	HCO_3^-	CO_3^{2-}	Ca^{2+}	Mg^{2+}	Na^+	K^+	Total alkalinity mmol/100g	Na^+ mmol/100g	
0～7	9.20	0.976	0.032	0.022	0.059	0.044	0.007	0.002	0.293	0.0003	15.484	6.832	1.024
7～40	9.40	0.770	0.026	0.054	0.103	0.058	0.005	0.004	0.219	0.0005	20.668	12.314	0.544
40～73	9.90	0.400	0.018	0.005	0.077	0.102	0.002	0.0005	0.113	0.0003	18.810	12.803	0.382
73～120	9.85	0.342	0.018	0.009	0.059	0.079	0.0005	0.003	0.120	0.0002	18.638	9.565	/

Note: the full name of Cl^- is chloride ion, the full name of SO_4^{2-} is Sulfate, the full name of HCO_3^- is carbonic acid hydrogen radical, the full name of CO_3^{2-} is carbonate, the full name of Ca^{2+} is calcium ion, the full name of Mg^{2+} is magnesium ion, the full name of Na^+ is natrium ion, the full name of K^+ is Kalium ion.

Table S3 Application ratio of soil amendment

Handling names	Application ratio of soil amendment（%）
TRZ (rural soil）	/
TH1 (TRY, salt-alkali soil）	0
TH2	5%
TH3	15%
TH4	25%
TH5 (TRH)	35%

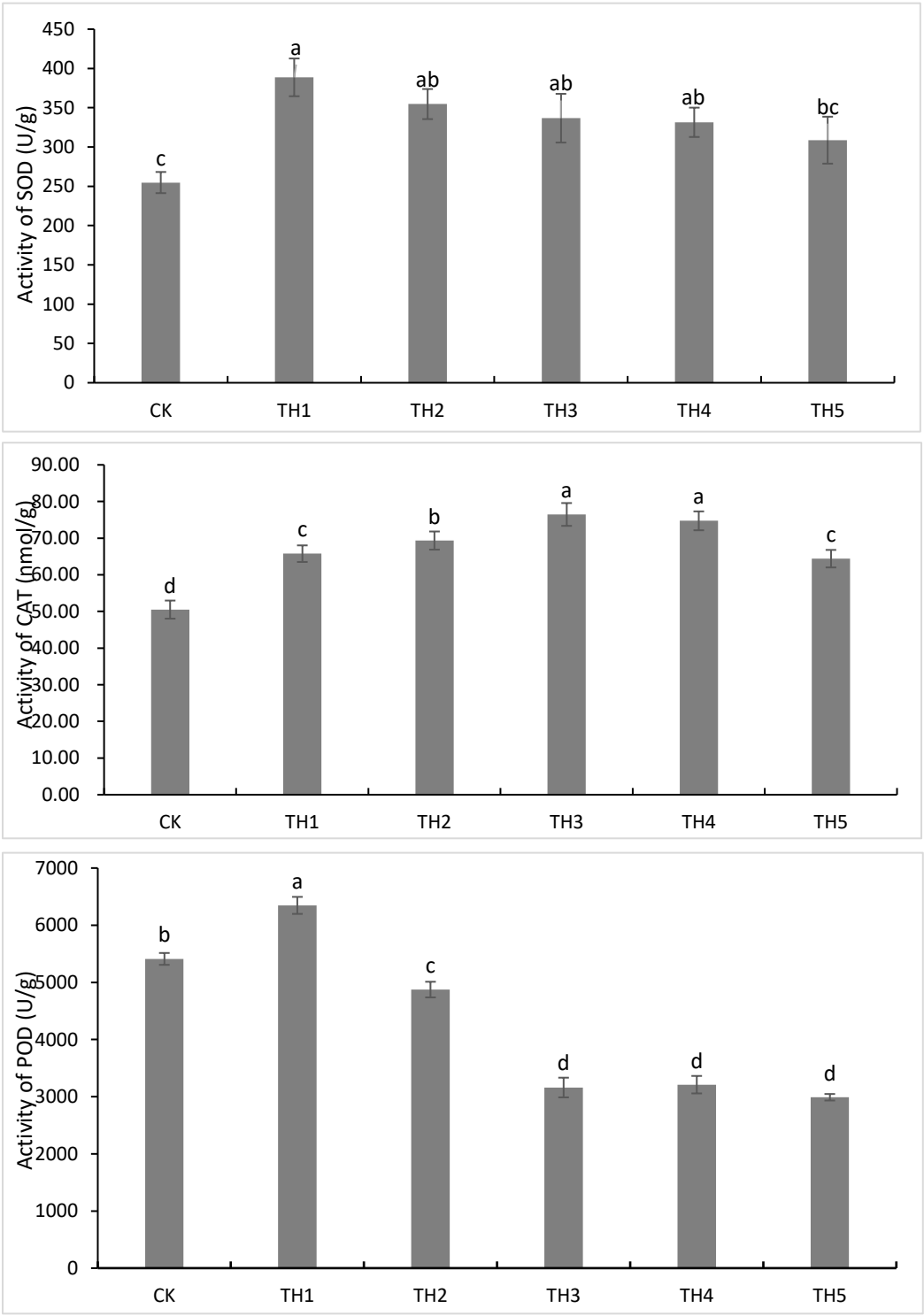

Figure S1 The effect of different treatments on SOD, CAT, and POD activities in melon under salt-alkali stress.

Note: Data are presented as mean ± S.E (n = 3). Containing the same letter indicates no significant difference at the $p < 0.05$ level based on Tukey's HSD test.

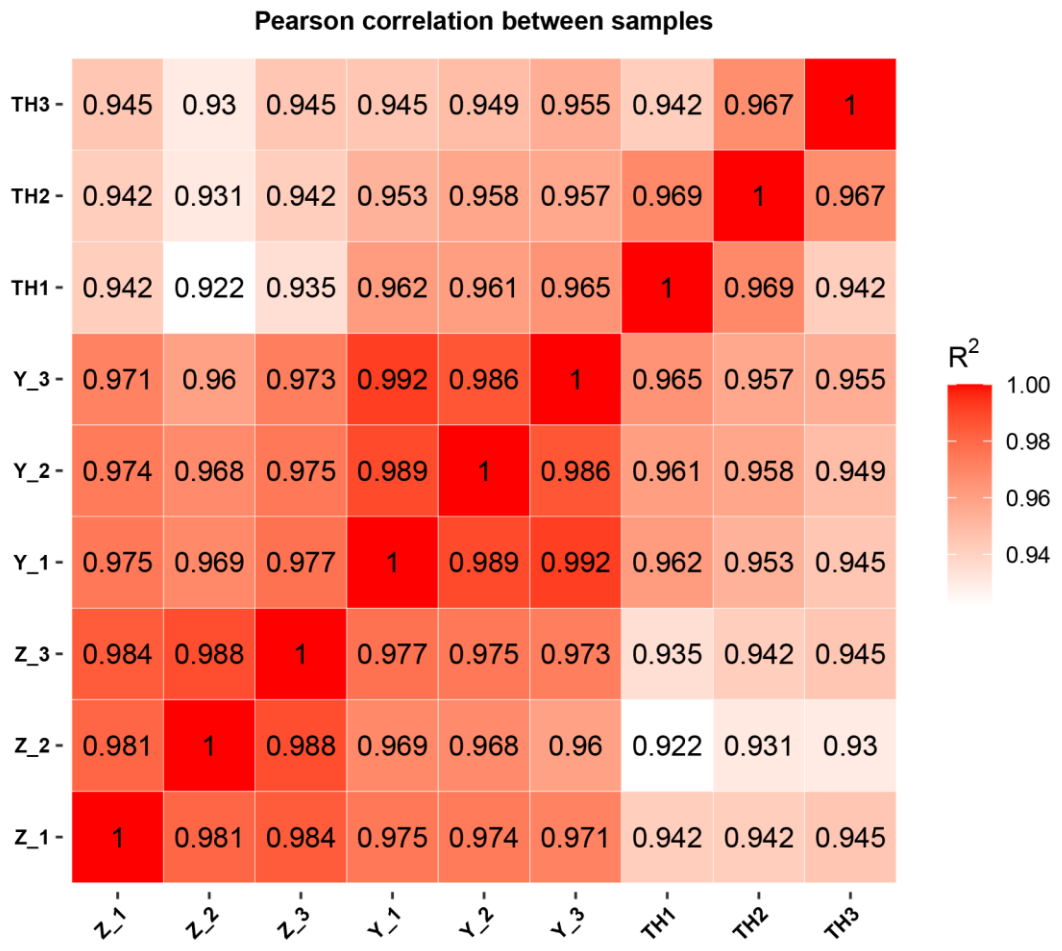

Figure S2 Repeatability of the melon samples.

Note: TH3-/TH2-/TH1-: melon samples from salt-alkali soil treated with 35% volcanic ash; Y_3-/Y_2-/Y_1-: melon samples from salt-alkali soil; Z_3-/Z_2-/Z_1-: melon samples from rural soil.

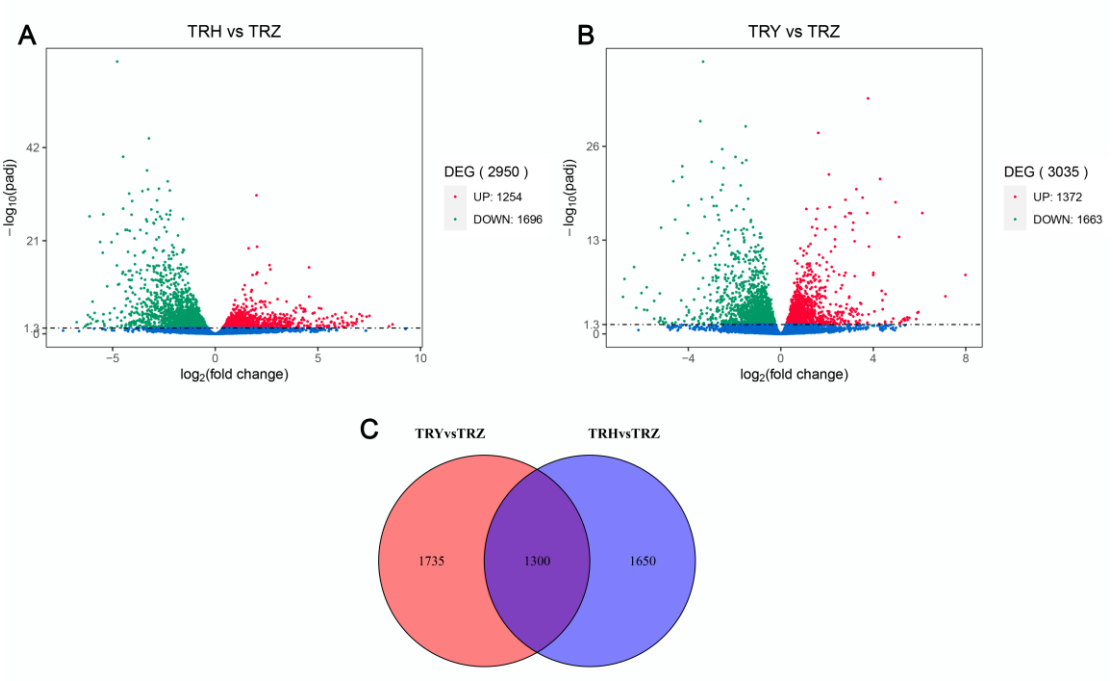

Figure S3 Variations in the number of DEGS in melon under different salt-alkali stress.

Note: A: differential gene volcano plot for the TRH and TRZ groups; B: differential gene volcano plot for the TRY and TRZ groups; C: venn diagram of DEGs between the TRH vs TRZ and the TRY vs TRZ group.

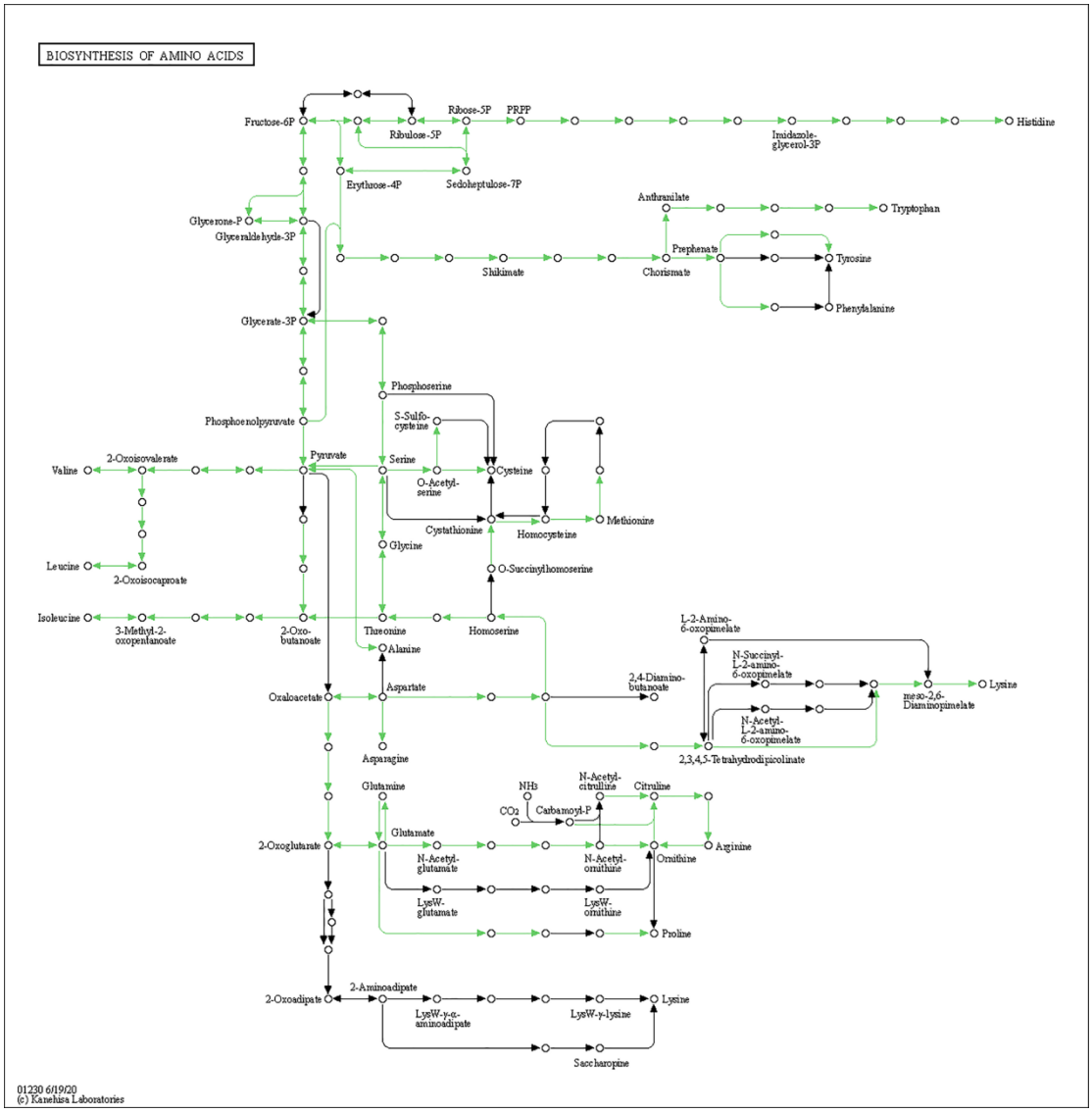

Figure S4 KEGG pathway of biosynthesis of amino acids.

Note: KEGG enriched pathway metabolic map was produced at https://www.kegg.jp website.

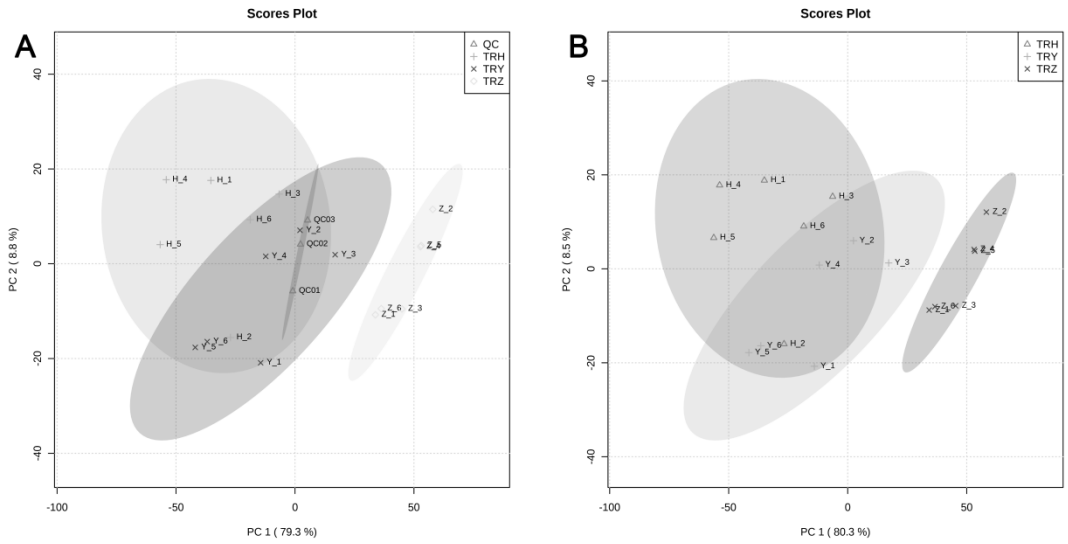

Figure S5 Metabolomic PCA including QC and excluding QC.

Note: A: metabolomic PCA including QC; B: metabolomic PCA excluding QC; the full name of PCA is principal components analysis; the full name of QC is quality control.

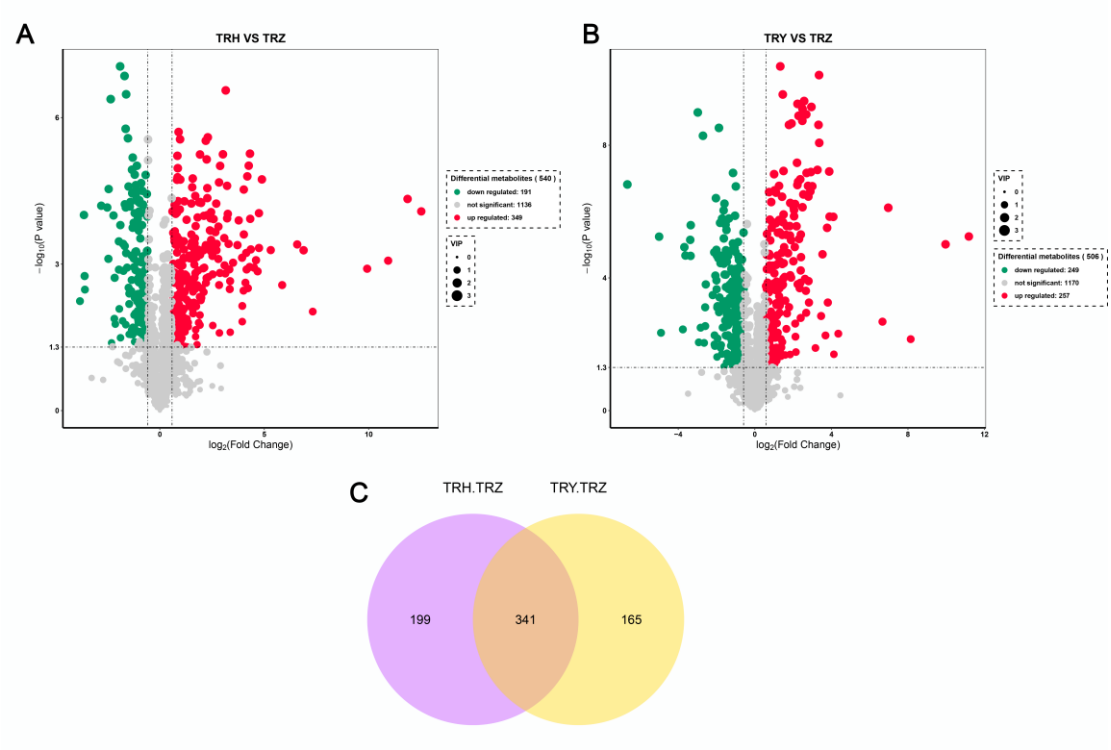

Figure S6 Metabolic changes in melon under different salt-alkali stress.

Note: A: differences in metabolic volcano plots between TRH and TRZ; B: differences in metabolic volcano plots between TRY and TRZ; C: venn diagram of metabolic differences between two comparison groups.