

Supplementary materials:

Table S1: List of varieties for the first open-field experiment.

| SN | Variety | Code | Source | Growth habit | Description |
|----|---------------------|------|---------------|---------------------|--|
| 1 | Amelia* | AMEL | Seeds n Such | Determinate, 75 d | Hybrid, heat/humidity tolerant, Large, 8 to 10-oz., firm, bright |
| 2 | Arkansas Traveler*~ | ARKA | Seeds n Such | Indeterminate, 87 d | Hybrid, reddish-pink, smooth to a bit rough, weigh 6 to 8-oz |
| 3 | Better Bush | BETB | Syngenta | Determinate, 68 d | Hybrid, medium to large, 8 oz. |
| 4 | BHN 589*~ | BHN5 | BHN Seed | Semi-determinate, | Hybrid, large, 8 to 10-oz., crack-resistant fruits |
| 5 | BHN-1021*~ | BHN1 | Johnny's Seed | Determinate, 76 d | Hybrid, 8-16 oz. bright-red slicers |
| 6 | Big Beef | BIGB | Johnny's Seed | Indeterminate, 73 d | Hybrid, Large, 10-12 oz. fruit |
| 7 | Black Krim | BLKR | Johnny's Seed | Indeterminate, 80 d | Heirloom, Deep brown/red, 8-16 oz. |
| 8 | Black Prince | BLPR | Johnny's Seed | Indeterminate, 74 d | Heirloom, 3–5 oz |
| 9 | Bolseno F1 | BOLS | Johnny's Seed | Indeterminate, 75 d | Hybrid, 7–12 oz. fruits |
| 10 | Carbon | CARB | Johnny's Seed | Indeterminate, 76 d | Heirloom, 10-14 oz. fruit |
| 11 | Dixie Red | DIXI | Seeds n Such | Determinate, 70 d | Hybrid, Large, 10-oz. fruits |
| 12 | Estiva* | ESTI | Johnny's Seed | Indeterminate, 70 d | Hybrid, 7-9 oz. fruits |
| 13 | FL 91*~ | FL91 | Seminis | Determinate, 72 d | Hybrid, Very large, 10-oz. |
| 14 | Fall 2018-253 | FAL | TAMU-WES | Early Determinate | Inbreed line, large cherry type, sweet, pink fruits |
| 15 | TAM-FLW1 | FLW1 | TAMUWES | Determinate, 75 d | Hybrid, large beefsteak, red fruits |
| 16 | TAM-FLW3~ | FLW3 | TAMU-Carlos | Determinate, 75 d | Hybrid, large beefsteak, red fruits |
| 17 | Heat Master*~ | HEAT | Seeds n Such | Determinate, 75 d | Hybrid, 7 to 8-oz., deep red fruits |
| 18 | HM-1823*~ | HM | Clifton Seed | Determinate, | Hybrid, large to X-large |
| 19 | Homestead* | HOME | Seeds n Such | Determinate, 80 d | Hybrid, 8 oz., bright red fruits |

Table S1 Continued

| SN | Variety | Code | Source | Growth habit | Description |
|----|-------------------|------|------------------------|---------------------|--|
| 20 | HT 1*~ | HT1 | TAMU-CS | Determinate, 75 d | Heirloom, 10 oz fruits |
| 21 | HT 2* | HT2 | TAMU-Crosby | Determinate, 75 d | Heirloom, 8-10 oz fruits |
| 22 | LaF44* | LaF4 | TAMU-Crosby | Determinate, 75d | Hybrid, 6 oz fruits |
| 23 | LaF77 | LaF7 | TAMU-Crosby | Determinate, 75d | Hybrid, 6-7 oz fruits |
| 24 | LaF66* | LaF6 | TAMU-Crosby | Determinate, 75 d | Hybrid, 6-7 sized fruits |
| 25 | Manalucie FSt | MANA | Seeds n Such | Indeterminate, 82 d | Hybrid, Large, bright red, globe-shaped, 1-lb. fruits |
| 26 | New Girl*~ | NEWG | Johnny's Seed | Indeterminate, 62 d | Hybrid, 4-6 oz. fruit |
| 27 | Phoenix*~ | PH | Seminis Vegetable Seed | Determinate, 72 d | Hybrid, Bright red, 8-oz. fruits |
| 28 | Picus*~ | PICU | Seeds n Such | Determinate, 79 d | Hybrid, 4 to 5-oz., deep red, roma-shaped, blocky fruits |
| 29 | Porter | PORT | Seeds n Such | Indeterminate, 78 d | Hybrid, small, 2-oz., plum-shaped, smooth, dark pink |
| 30 | Pruden's Purple*~ | PP | Johnny's Seed | Indeterminate, 67 d | Heirloom, Large to very large (many over 1 lb.) fruits |
| 31 | Rally* | RALY | Sakata Seed America | Determinate, 72 d | Hybrid, 9-10 oz. large red fruits |
| 32 | RS 1 | RS1 | TAMU | Determinate, 75d | Hybrid, 5-7 oz fruits |
| 33 | RS 8 | RS8 | TAMU | Determinate, 75d | Hybrid, 6-8 oz fruits |
| 34 | Shourouq*~ | SQ | Seminis Vegetable Seed | Determinate, 75 d | Hybrid, 8-12 oz fruits |
| 35 | Skyway | SYW | Johnny's Seed | Determinate, 78 d | Hybrid, 8-12 oz. fruits |
| 36 | Summerpick | SUME | Syngenta | Determinate, 75 d | Hybrid, extra-large to jumbo, 11.3 oz. fruit |
| 37 | Tasti-Lee*~ | TL | Bejo Seeds, Inc | Determinate, | Hybrid |
| 38 | Tribeca*~ | TRIB | Vilmorin | Determinate, 70 d | Hybrid, 9-10 oz. |
| 39 | Valley Girl*~ | VG | Johnny's Seed | Determinate, 65 d | Hybrid, 7-8 oz. globe-shaped red fruits |

Table S1 Continued

| SN | Variety | Code | Source | Growth habit | Description |
|----|--------------|------|---------------------------|----------------------|---|
| 40 | Wisconsin 55 | WISC | Johnny's Seed | Indeterminate, 80 d | Hybrid, 6–8 oz. fruits |
| 41 | Bella Rosa*~ | BR | Sakata Seed America, Inc. | Determinate, 74 d | Hybrid, Large, 10 to 12-oz., round, deep red, firm fruits |
| 42 | Celebrity*~ | CELE | Clifton Seed | Determinate, 70-75 d | Hybrid, 7-8 oz, globe-shaped, firm red fruits |
| 43 | Tonopah | TONO | Seeds n Such | Determinate, 67 d | Hybrid, 10 oz, globe-shaped red fruits |

*genotypes used in open field experiments in both 2019/2020, ~ genotypes used in control environment experiment.

Table S2: ANOVA of different parameters measured in the second experiment (greenhouse and growth-chamber) as influenced by varieties (var) and heat-treatments (trt).

| Parameter | SOV | P-value | Significance |
|--------------------------------------|---------|----------|--------------|
| Chlorophyll Fluorescence (CF) | var | 5.98E-06 | *** |
| | trt | 1.88E-11 | *** |
| | var*trt | 3.48E-06 | *** |
| SPAD | var | 1.69E-11 | *** |
| | trt | < 2e-16 | *** |
| | var*trt | 0.00428 | ** |
| Plant Height (Ht) | var | 2.21E-08 | *** |
| | trt | < 2e-16 | *** |
| | var*trt | 0.000347 | *** |
| Stem Diameter (D) | var | 5.83E-08 | *** |
| | trt | 5.86E-09 | *** |
| | var*trt | 9.21E-07 | *** |
| Heat Injury Index (HII) | var | <2e-16 | *** |
| | trt | <2e-16 | *** |
| | var*trt | <2e-16 | *** |

***, **, * show significant difference at $P \leq 0.001, 0.01, 0.05$, respectively.

NS means not significant at $P \leq 0.05$.

Table S3: ANOVA of different parameters as influenced by varieties (var) and stages (Stage-1: 56 DAT, 34 °C and Stage-2: 86 DAT, 41°C).

| SN | Parameter | SOV | P-value | Significance |
|----|--|-------------|----------|--------------|
| 1. | Net Photosynthesis Rate (Pn) | Var | 0.8253 | NS |
| | | Stage | 0.0605 | NS |
| | | Block | <2e-16 | *** |
| | | Var × Stage | 0.804 | NS |
| 2. | Stomatal Conductance (gs) | Var | 0.1892 | NS |
| | | Stage | <2e-16 | *** |
| | | Block | 0.0786 | NS |
| | | Var × Stage | 0.0833 | NS |
| 3. | Intercellular CO ₂ Concentration (Ci) | Var | 0.771 | NS |
| | | Stage | <2e-16 | *** |
| | | Block | 1.31E-13 | *** |
| | | Var × Stage | 0.892 | NS |
| 4. | Transpiration rate (E) | Var | 0.00752 | ** |
| | | Stage | 5.88E-06 | *** |
| | | Block | 2.76E-05 | *** |
| | | Var × Stage | 0.02974 | * |
| 5. | Leaf Temperature (LT) | Var | 1 | NS |
| | | Stage | < 2e-16 | *** |
| | | Block | 3.36E-09 | *** |
| | | Var × Stage | 0.999 | NS |
| 6. | Initial Fluorescence (Fo) | Var | 0.0977 | NS |
| | | Stage | <2e-16 | *** |
| | | Block | 2.46E-09 | *** |
| | | Var × Stage | 0.1675 | NS |
| 7. | Maximum Fluorescence (Fm) | Var | 0.00143 | *** |
| | | Stage | < 2e-16 | *** |
| | | Block | < 2e-16 | *** |
| | | Var × Stage | 0.00337 | ** |
| 8. | SPAD value | Var | 7.31E-11 | *** |
| | | Stage | < 2e-16 | *** |
| | | Block | 0.58358 | NS |
| | | Var × Stage | 0.00545 | ** |

Table S3: Continued

| SN | Parameter | SOV | P-value | Significance |
|-----|--|-------------|----------|--------------|
| 9. | Chlorophyll Fluorescence (CF) | Var | 0.131 | NS |
| | | Stage | < 2e-16 | *** |
| | | Block | 7.02E-07 | *** |
| | | Var × Stage | 0.134 | NS |
| 10. | Instantaneous Water Use Efficiency (WUE _{inst}) | Var | 0.836 | NS |
| | | Stage | 8.30E-08 | *** |
| | | Block | < 2e-16 | *** |
| | | Var × Stage | 0.97 | NS |
| 11. | Intrinsic Water Use Efficiency WUE _{intr} | Var | 0.682 | NS |
| | | Stage | < 2e-16 | *** |
| | | Block | 6.15E-12 | *** |
| | | Var × Stage | 0.796 | NS |
| 12. | Electrolyte Leakage (EL) | Var | < 2e-16 | *** |
| | | Stage | < 2e-16 | *** |
| | | Block | 0.2 | NS |
| | | Var × Stage | 7.68E-13 | *** |
| 13. | Heat Injury Index (HII) | Var | < 2e-16 | *** |
| | | Stage | 1.11E-06 | *** |
| | | Block | 0.92813 | NS |
| | | Var × Stage | 0.00262 | ** |
| 14. | Marketable Yield | Var | 3.4e-12 | *** |
| | | Block | 0.124 | |

***, **, * show significant difference at $P \leq 0.001, 0.01, 0.05$, respectively.

NS means not significant at $P \leq 0.05$.

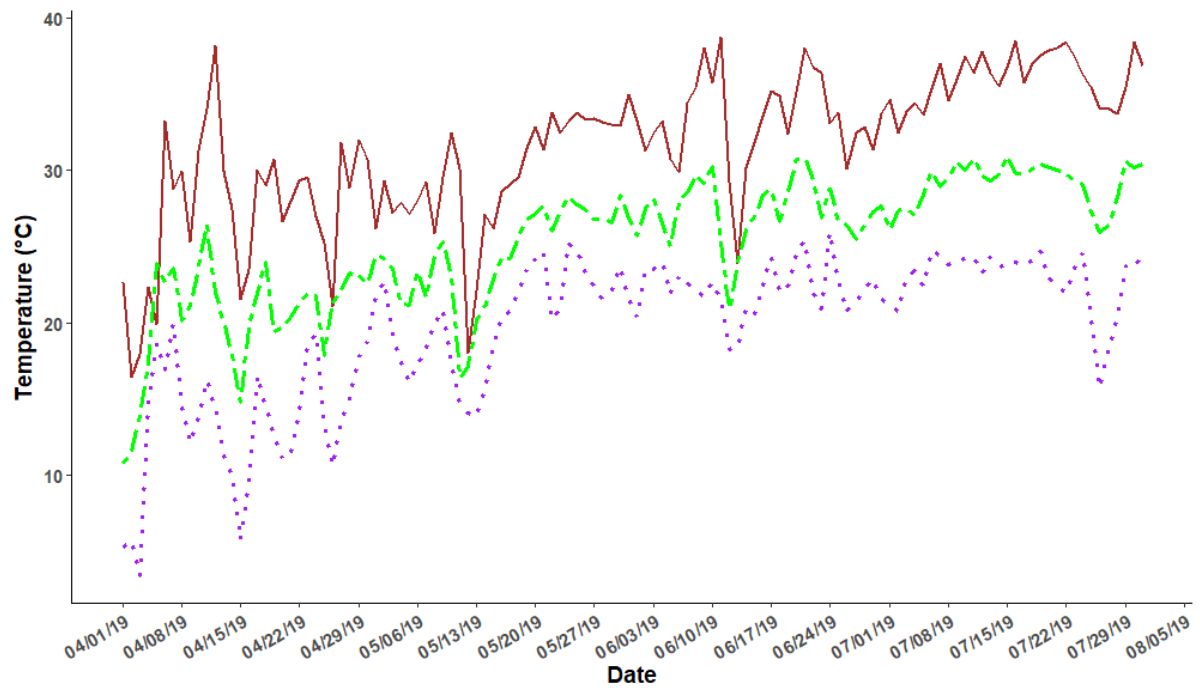


Figure S1: Temperature graph for Uvalde, TX from April 2019–July 2019, when the tomato plants were grown in the open-field for heat-stress tolerance screening. The brown, green, and purple lines indicate daily maximum, average, and minimum temperatures, respectively.

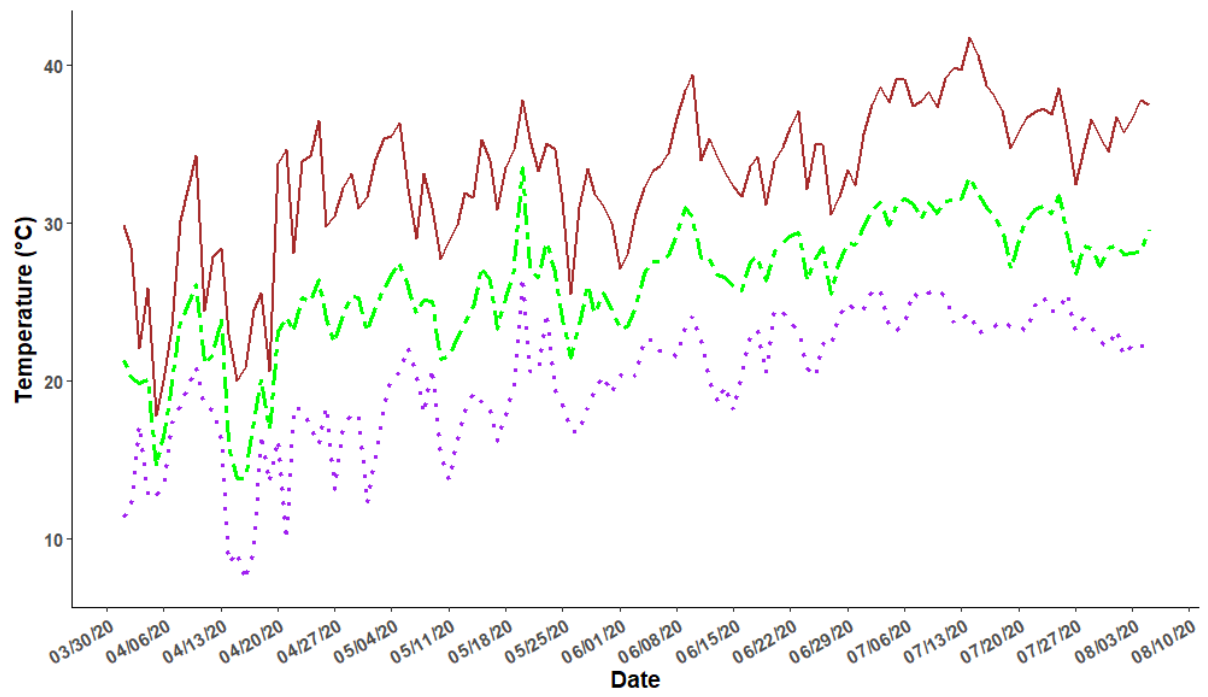


Figure S2: Temperature graph for Uvalde, TX from April 2020–July 2020, when the tomato plants were grown in the open-field for heat-stress tolerance screening. The brown, green, and purple lines indicate daily maximum, average, and minimum temperatures, respectively.