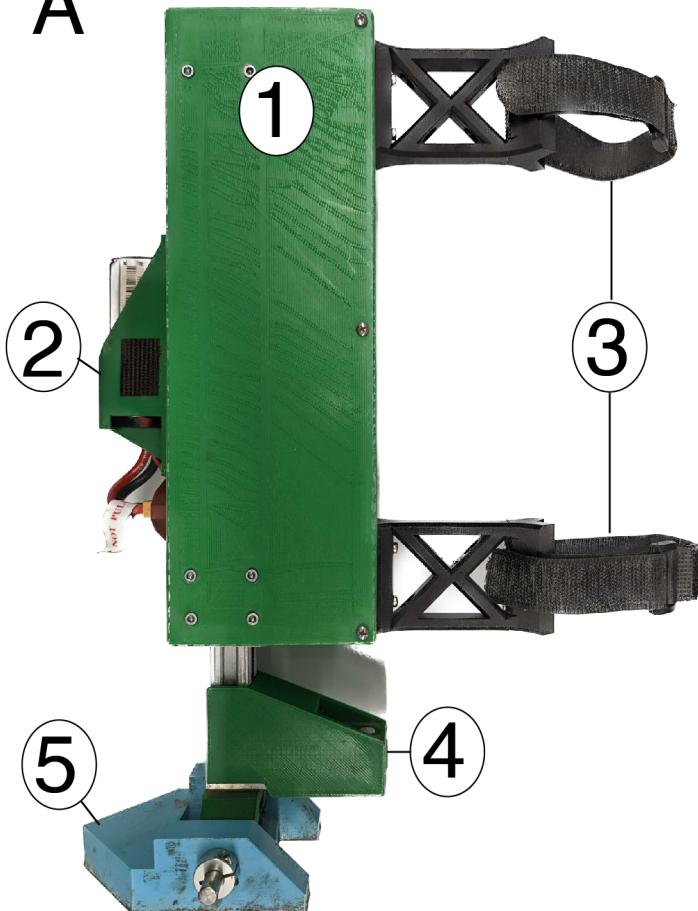
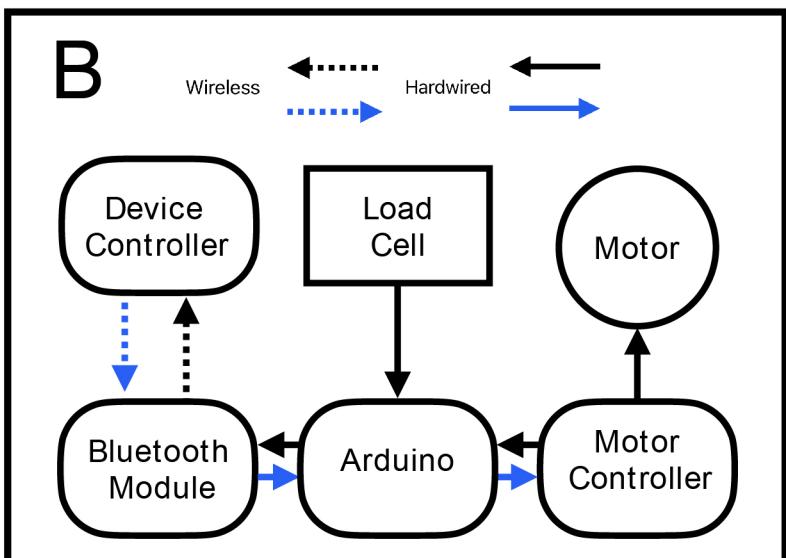


**Supplemental Figure S1. Root lodging susceptibility is variable among maize hybrids and random in the field.** (A) Winds from the West and North-West induced root lodging at our Newark, DE field site. Plots were colored according to their root lodging susceptibility, with dark red indicating high root lodging and white indicating no root lodging. Hybrid information is indicated on each plot and shows that root lodging susceptibility was not associated with field location. (B) Root lodging susceptibility was quantified in 2020 ((root lodged plants)/(total plants within plot)× 100) at our field location following Tropical Storm Isaias. Some hybrids had 100% root lodging in both plot replicates while other hybrids had variable or 0% root lodging in both plot replicates.

**A**

- (1) Case; (2) Battery;  
(3) Arms; (4) Load Cell;  
(5) Foot

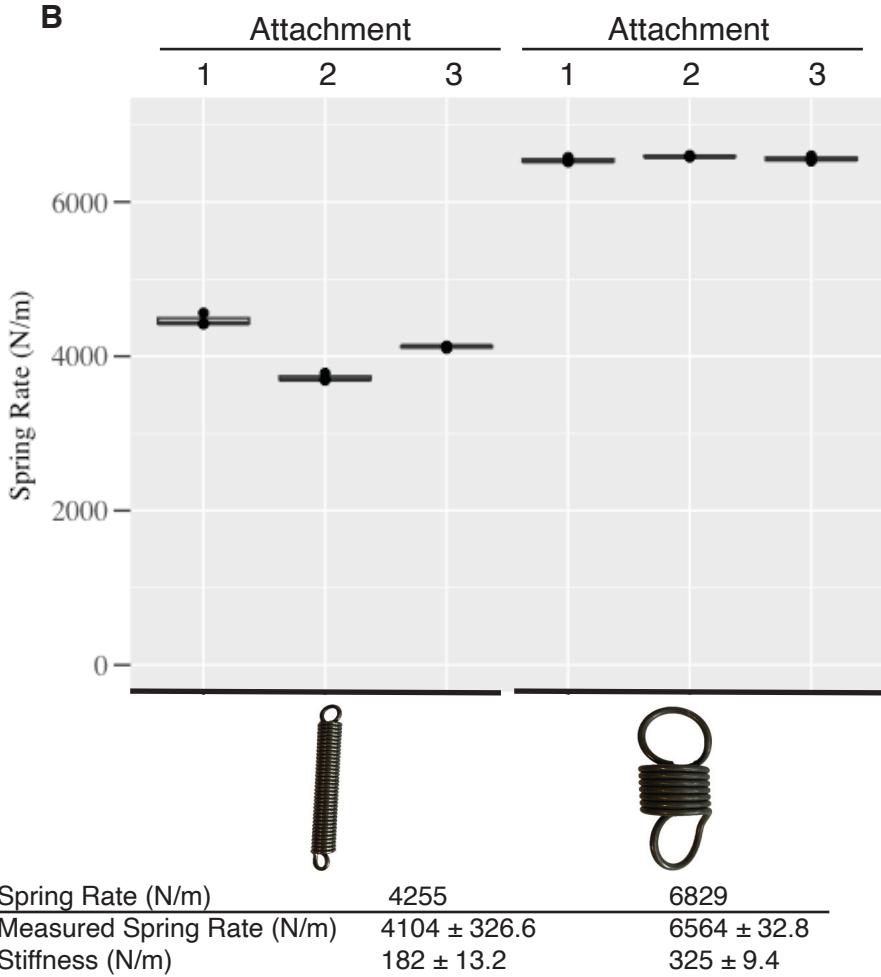


**Supplemental Figure S2. Overview of SMURF device.** (A) The physical body is composed of (1) a 3D-printed case housing the electronics and powertrain, (2) a battery pack, (3) a set of arms with straps to attach the device to the plant and limit stalk bending, (4) a sensor housing case for the 10 kg load cell, and (5) a rotational foot for device grounding. (B) The internal electronics, located within the 3D-printed case, are run via an Arduino microcontroller that connects a motor driver, load cell amplifier, and Bluetooth module. Dotted lines indicate a wireless connection, whereas solid lines indicate a hardwired connection between components.

A



B

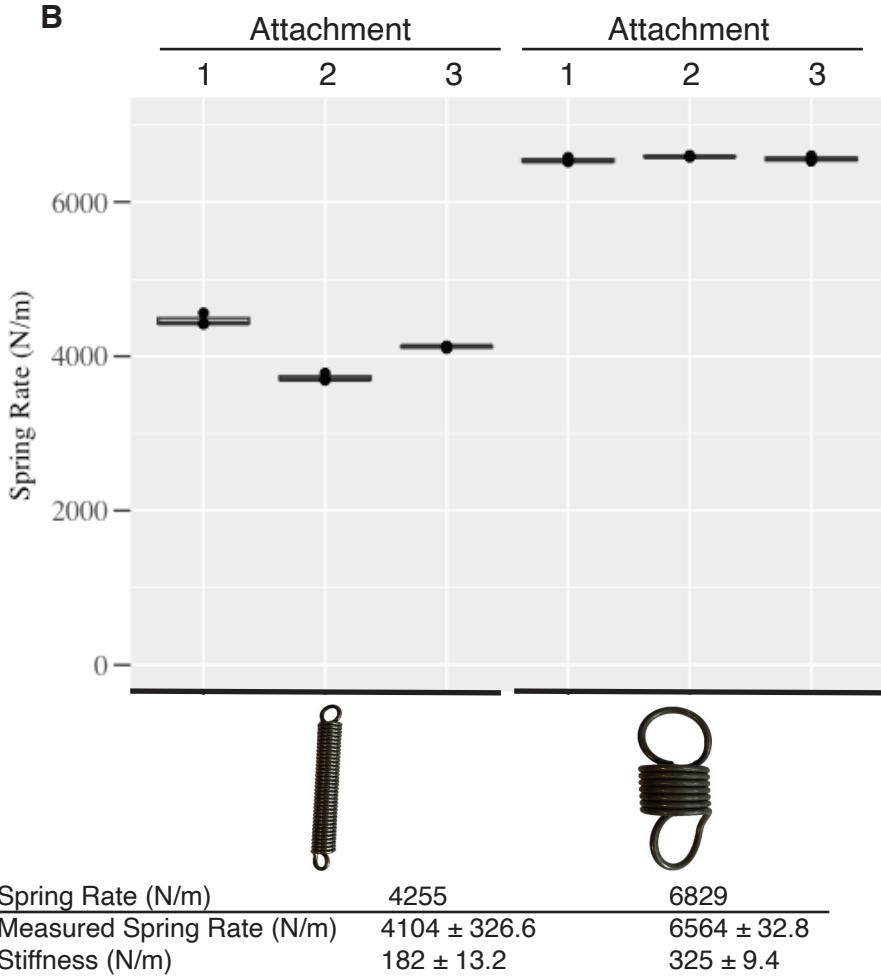


**Supplemental Figure S3. Device validation testing stand.** A) A validation stand was constructed to demonstrate the SMURF device can distinguish between the stiffness of different springs. The device consists of a hinged rod attached to a metal base plate where a 2.5-in spring can be attached to provide different levels of resistance. B) Two springs with known spring rates were used in the validation testing. The device was attached three times, and three tests were run per attachment. The measured spring rate was extrapolated from the SMURF-provided root system stiffness. The measured spring rate and stiffness values displayed are the group mean +/- the standard deviation.

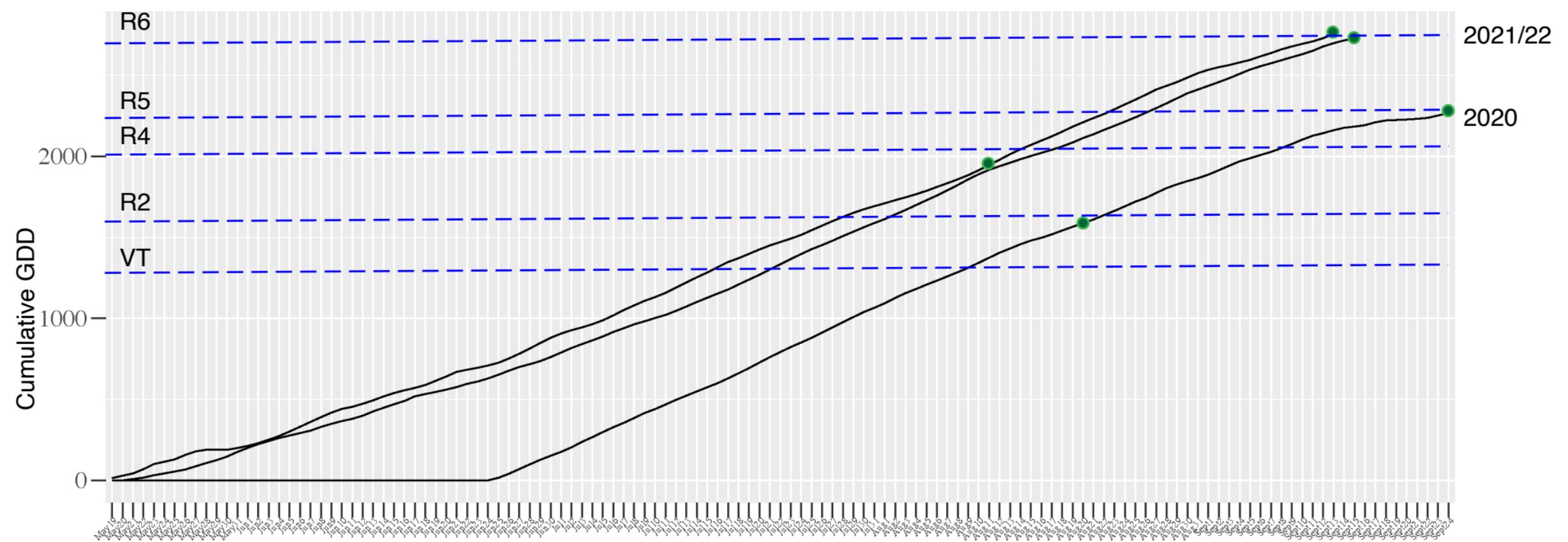
A



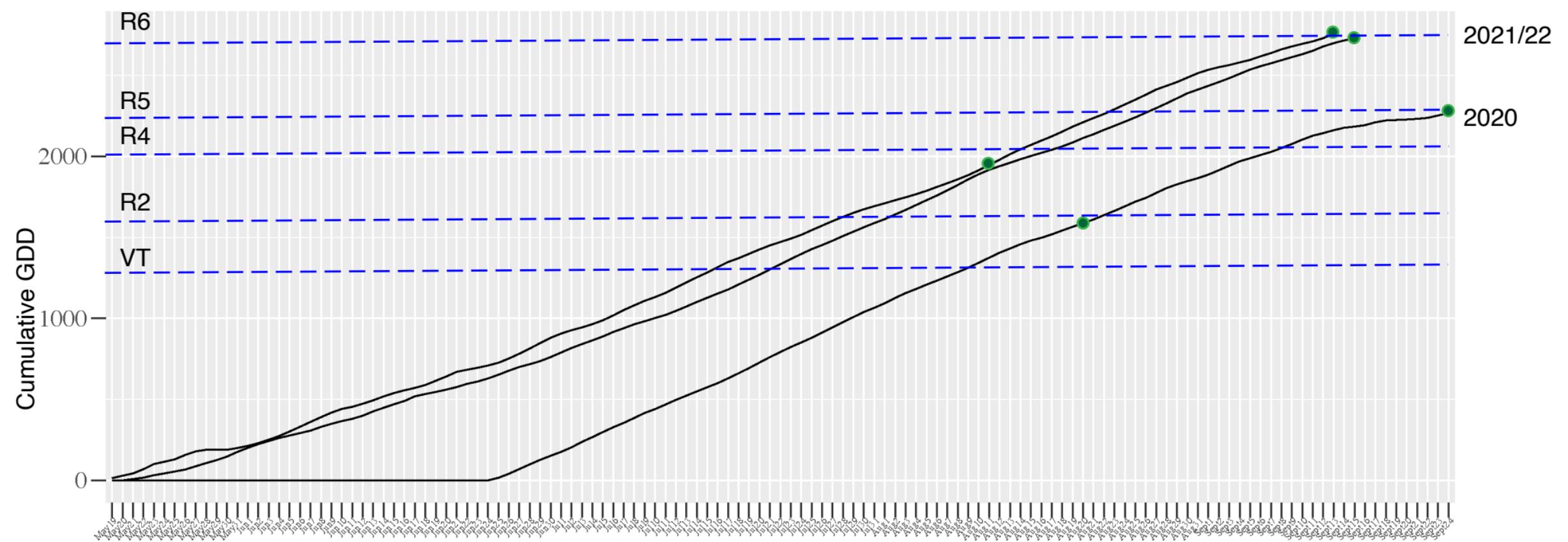
B



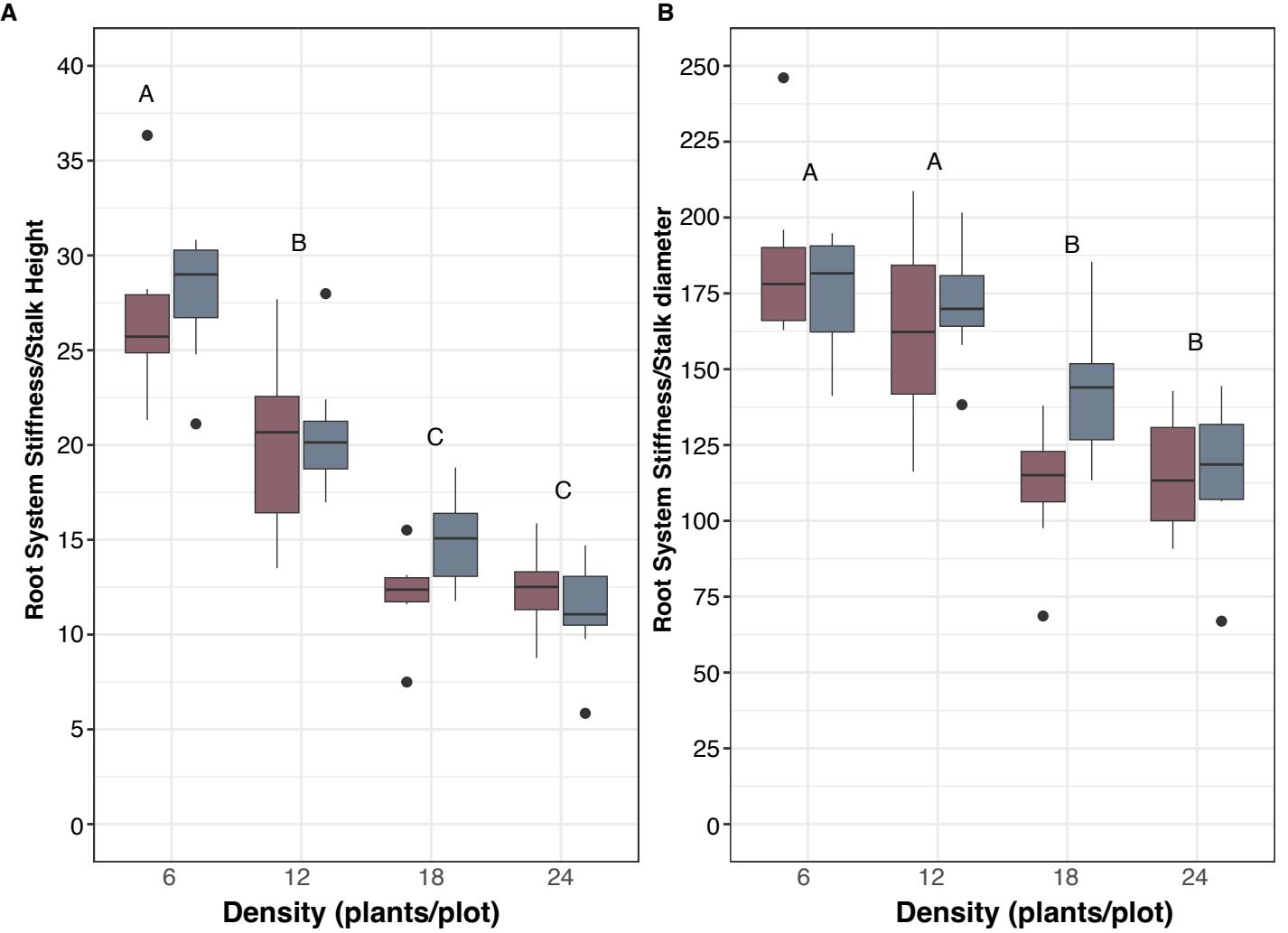
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**Supplemental Figure S4. Cumulative Growing Degree Day Data.** The cumulative growing degree day (GDD) was assessed for the three years of data collected. Green dots indicate data collection points.



**Supplemental Figure S4. Cumulative Growing Degree Day Data.** The cumulative growing degree day (GDD) was assessed for the three years of data collected. Green dots indicate data collection points.



**Supplemental Figure S5. Root system stiffness varies with stalk height and stalk diameter.**  
 Two maize hybrids (LH82 x DK3IIH and LH82 x PHP02) were planted at four densities (6, 12, 18, and 24 plants/plot). The ratio of root system stiffness to (A) stalk height and (B) average stalk diameter was determined. (A) As planting density increases, the ratio of root system stiffness/stalk height decreases. A two-way ANOVA (Hybrid\*Density) revealed that the hybrid did not impact the ratio of root system stiffness/stalk height, but planting density did ( $p < 0.05$ ). (B) As planting density increases, the ratio of root system stiffness/stalk diameter decreases. A two-way ANOVA (Hybrid\*Density) revealed that the hybrid did not impact the ratio of root system stiffness/stalk diameter, but planting density did ( $p < 0.05$ ). (A-B) Within each panel (root system stiffness/stalk height or root system stiffness/stalk diameter), densities that share a letter do not significantly differ (Tukey HSD assessed at  $p < 0.05$ ). Letters illustrate differences between plant densities but not hybrid. Black dots indicate outliers.