CLAIMS

What is claimed is:

1. A sensor for measuring plant part size and/or other plant part characteristics, comprising:

a) one or more fasteners configured to be positioned in or around a plant part;

b) two or more components selected from the group consisting of: a dendrometer, an accelerometer, a temperature sensor, a humidity sensor, and a light sensor;

c) a processor; and

d) a power supply.

2. The sensor of claim 1, wherein the sensor comprises a printed circuit board (PCB); wherein optionally one or all of the components, the processor, and the one or more fasteners is/are affixed to the PCB; and wherein optionally the PCB comprises an epoxy-fiberglass composite material.

3. The sensor of any one of claims 1-2, wherein the power supply comprises a battery.

4. The sensor of any one of claims 1-3, wherein the power supply comprises a solar panel; wherein optionally the power supply comprises an integrated solar panel, hybrid capacitor, and lithium battery, wherein optionally the battery is a coin cell battery; and wherein optionally the processor comprises a PCB, and wherein the battery and/or solar panel is/are affixed to the PCB.

5. The sensor of any one of claims 1-4, further comprising a housing that encloses at least the processor and power supply; wherein optionally:

the housing is or comprises molded plastic, optionally comprising an O-ring;

an over-molding covers the processor, components, and PCB to hermetically seal the PCB; and/or

the housing is or comprises a polymer resin, optionally a glass-filled resin, optionally comprising 10-40% glass or 30% glass.

6. The sensor of any one of claims 1-5, wherein the sensor comprises a dendrometer.

7. The sensor of claim 6, wherein the dendrometer comprises:

1) a plunger having a shaft, wherein the plunger is configured to be positioned against the plant part, and wherein the plunger is configured to move laterally in proportion to a change in plant size;

2) a magnet attached to or within the shaft, wherein the magnet is configured to move laterally in association with the plunger; and

3) a magnetometer configured to detect position of the magnet;

wherein optionally the magnetometer is configured to measure magnetic field strength in multiple axes;

wherein optionally the magnet is neodymium magnet; and/or

wherein optionally the sensor comprises a PCB, and wherein the magnetometer is affixed to the PCB.

8. The sensor of any one of claims 1-7, wherein the sensor is configured to measure change in diameter or radius of the plant part.

9. The sensor of any one of claims 1-8, wherein the sensor is configured to measure plant part size multiple times per day; wherein optionally the sensor is configured to measure plant part size at an interval of 15 minutes or less, 5 minutes or less, or at an interval of 5 seconds.

10. The sensor of any one of claims 1-9, wherein the sensor comprises an accelerometer; wherein optionally the accelerometer is a 3-axis accelerometer; and/or wherein the sensor comprises a PCB, and the accelerometer is affixed to the PCB.

11. The sensor of any one of claims 1-10, wherein the sensor comprises a temperature sensor; wherein optionally the sensor comprises a PCB, and the temperature sensor is affixed to the PCB.

12. The sensor of any one of claims 1-11, wherein the sensor comprises a humidity sensor; wherein optionally the sensor comprises a PCB, and the humidity sensor is affixed to the PCB.

13. The sensor of any one of claims 1-12, wherein the sensor comprises a light sensor; wherein optionally the sensor comprises a PCB, and the light sensor is affixed to the PCB.

14. The sensor of any one of claims 1-13, wherein the sensor comprises a dendrometer and one or more of: an accelerometer, a temperature sensor, a humidity sensor, and a light sensor; wherein optionally the sensor comprises a dendrometer, an accelerometer, a temperature sensor, a humidity sensor, and a light sensor.

15. The sensor of any one of claims 1-14, further comprising a transmitter; wherein optionally the transmitter is:

(a) a Bluetooth radio or transceiver, optionally a Bluetooth Low Energy (BLE) radio or transceiver;

(b) a Long Range (LoRa) transceiver; or

(c) a Near Field Communication (NFC) transceiver; and

wherein optionally the sensor comprises a PCB, and the transmitter is affixed to the PCB.

16. The sensor of any one of claims 1-15, wherein:

(a) the one or more fasteners comprises a screw, threaded rod, or nail, and wherein the screw, threaded rod, or nail is configured to be positioned within the plant part and mount the sensor to the plant part; or

(b) the one or more fasteners comprises one or more curved arm(s), wherein the curved arm(s) are configured to be positioned around the plant part, wherein optionally the one or more fasteners comprises two curved arms arranged in a V-shape and/or the curved arm(s) are configured to be positioned around the plant part; and

wherein optionally the one or more fasteners further comprises an elastic band configured to be wrapped around the sensor and the plant part; and/or the one or more fasteners comprises a

screw, wherein the sensor comprises a PCB, and wherein the screw is affixed to the PCB, and wherein the PCB optionally comprises a compression-limiting element around the screw.

17. The sensor of any one of claims 7-16, wherein:

(a) the plunger cap further comprises a gimbal;

(b) the plunger cap is or comprises molded plastic;

(c) the plunger cap is less than about 3mm in thickness;

(d) the plunger cap is configured to contact the plant part over a surface area of between about 10 mm^2 and about 100 mm^2;

(e) the sensor further comprises a spring around or affixed to the plunger;

(f) the sensor further comprises a pull tab attached to the plunger shaft opposite the plunger cap; and/or

(g) the plunger shaft comprises aluminum or stainless steel, optionally wherein the plunger shaft is a hollow cylinder, and the magnet is a cylindrical magnet positioned inside the plunger shaft.

18. The sensor of any one of claims 16-17, wherein:

(a) the screw, threaded rod, or nail comprises stainless steel, brass, aluminum, or titanium; and/or

(b) the one or more fasteners comprises a screw, and wherein the sensor further comprises a nut configured to be positioned around the screw between the sensor and the plant part, optionally wherein the sensor further comprises a second nut configured to be positioned around the screw on a face of the sensor distal to the plant part.

19. The sensor of any one of claims 16-18, wherein the one or more fasteners comprises a screw having a first end and a second end, wherein the sensor further comprises:

(i) a compression-limiting element having a first opening and a second opening; and

(ii) a captive screw;

wherein the first end of the screw is configured to be positioned within the plant part and mount the sensor to the plant part;

wherein the first opening of the compression-limiting element is configured to receive the second end of the screw; and

wherein the second opening of the compression-limiting element is configured to receive the captive screw;

wherein optionally the sensor further comprises a retaining ring configured to be positioned around the captive screw.

20. The sensor of any one of claims 16-19, wherein the one or more fasteners comprises a threaded rod, and wherein the sensor further comprises a first nut configured to be positioned around the threaded rod between the plant part and the sensor and a second nut configured to be positioned around the threaded rod adjacent to the sensor and distal to the plant part.

21. The sensor of any one of claims 7-20, further comprising a hollow shuttle positioned around the plunger shaft.

22. The sensor of any one of claims 1-21, wherein:

(a) the plant is a tree or woody plant, optionally a crop tree, citrus, olive, nut, cacao, oak, pine, redwood, or maple tree, and optionally the plant part is a stem, trunk, bole, or branch; or

(b) the plant is a vine, optionally a grape vine, and optionally the plant part is a trunk, shoot, branch, cane, fruit, or stem.

23. A system for measuring plant part size and/or other plant part characteristics, comprising:

a) a sensor according to any one of claims 1-22; and

b) a mobile device and/or server;

wherein the sensor is connected to the mobile device and/or server via wireless communication and configured to transmit data to the mobile device and/or server; and optionally wherein the sensor is connected to the mobile device and/or server via Bluetooth low energy (BLE), Long Range (LoRa), Near Field Communication (NFC), or a combination thereof.

24. The system of claim 23, comprising:

(a) a mobile device, wherein the sensor is configured to transmit data to the mobile device; and/or

(b) a server, wherein the sensor is configured to transmit data to the server.

25. The system of any one of claims 23-24, wherein:

(a) the sensor is configured to transmit data related to one or more of: the magnetometer, plant part size, wireless communication signal strength, accelerometer, light sensor, humidity sensor, temperature sensor, or a combination thereof to the mobile device and/or server;

(b) the mobile device comprises a Global Positioning System (GPS) sensor, and the GPS sensor is configured to obtain location information using the GPS sensor and associate the location information with the sensor;

(c) the mobile device comprises a camera or other image sensor; and/or

(d) the system comprises a plurality of sensors according to any one of claims 1-22; wherein each sensor of the plurality is connected to the mobile device and/or server via wireless communication and configured to transmit data to the mobile device and/or server..

26. A system for measuring plant part size and/or other plant part characteristics of a plurality of plants, comprising a plurality of sensors according to any one of claims 1-22; wherein each sensor of the plurality is configured to measure plant part size and/or other plant part characteristics of a single plant of the plurality; and wherein the system optionally further comprises:

(a) a mobile device; wherein each sensor of the plurality is connected to the mobile device and configured to transmit data to the mobile device; and/or

(b) a server; wherein each sensor of the plurality is connected to the server and configured to transmit data to the mobile device.

27. A method for measuring size of a plant part and/or other plant part characteristics, comprising:

a) affixing a sensor according to any one of claims 1-22 to the plant part; and

b) measuring size and/or other plant part characteristics of the plant part based at least in part on data collected from the two or more components of the sensor;

wherein optionally the size and/or other plant part characteristics of the plant part is measured at a first time, and the method further comprises measuring size and/or other plant part characteristics of the plant part at a second time different from the first time, wherein the measurement of size and/or other plant part characteristics at the second time is based at least in part on data collected from the two or more components of the sensor.