
GENERAL INFORMATION

1. Title of Dataset: First Leaf Emergence Force of Winter Wheat

2. Abstract: Small, single-point load cells were used to measure force exerted by the first leaf of three hard red cultivars (Farnum, Finley, and Norwest 553) as it emerged from a deep planting depth in a small containerized volume of soil. Coleoptile diameter was determined using a 0 to 25 mm, ratchet-stop 102-301 micrometer (Mitutoyo America Corporation; Aurora, Ill). Diameter measurements were made five mm above the base (CDB), in the middle (CDM), and five mm below the tip (CDT) of the coleoptile. Images of the tip of nine first leaves were made with a Quanta 600 reduced pressure scanning electron microscope (SEM) housed in the Linus Pauling Science Center at Oregon State University in Corvallis. Software in the SEM automatically computed the surface area of a subjective (operator-selected) segment of the tip of the first leaf.

3. Author Information:

Principal Investigator Contact Information

Name: Larry K. Lutcher (L.K. Lutcher)
Institution: Oregon State University
Address: P.O. Box 397; Heppner, OR 97836
Email: larry.lutcher@oregonstate.edu

Associate or Co-investigator Contact Information

Name: Stewart B. Wuest
Institution: United States Department of Agriculture, Agricultural Research Service;
Soil and Water Conservation Research Unit
Address: 48037 Tubbs Ranch Road; Adams, OR 97810
Email: stewart.wuest@ars.usda.gov

Associate or Co-investigator Contact Information

Name: Tami R. Johlke (Retired)
Institution: United States Department of Agriculture, Agricultural Research Service;
Soil and Water Conservation Research Unit
Address: 48037 Tubbs Ranch Road; Adams, OR 97810
Email: tami.johlke@ars.usda.gov

4. Date of Data Collection: January 2014 to February 2016

5. Geographic Location of Data Collection:

Soil and Water Conservation Research Unit; United States Department of Agriculture,
Agricultural Research Service; 48037 Tubbs Ranch Road; Adams, OR 97810.

6. Information about Funding Sources that Supported the Collection of Data:

Morrow County General Fund. This fund is used to support research conducted by the agricultural program leader in north-central Oregon.

SHARING/ACCESS INFORMATION

1. **Licenses/Restrictions Placed on the Data:** CCO license; no restrictions
2. **Links to Publications that Cite or Use the Data:** To be determined; link will be added when paper is published.
3. **Links to Other Publically Accessible Locations of the Data:** None
4. **Links/Relationships to Ancillary Data Sets:** None
5. **Was data derived from another source?** No
6. **Recommended citation for the data:**
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DATA AND FILE OVERVIEW

1. File List

A. Before Buckling Emergence Force (BBEF) Data.csv

Short Description: Data used for statistical evaluation (analysis of variance and Tukey's honestly significant difference test); average of two observations per run for each cultivar. There were nine runs, and each run was a replication.

B. All Emergence Force Data for Farnum Hard Red Winter Wheat.csv

Short Description: All emergence force observations for this particular cultivar; collected at two minute intervals for 12 hours.

C. All Emergence Force Data for Finley Hard Red Winter Wheat.csv

Short Description: All emergence force observations for this particular cultivar; collected at two minute intervals for 12 hours.

D. All Emergence Force Data for Norwest 553 Hard Red Winter Wheat.csv

Short Description: All emergence force observations for this particular cultivar; collected at two minute intervals for 12 hours.

E. Coleoptile Diameter (CDB, CDM, and CDT) and Length (CLGTH) Data.csv

Short Description: Diameter measurements near the base (CDB), in the middle (CDM), and just below the tip (CDT) of the coleoptile. Data used for statistical evaluation (analysis of variance and Tukey's honestly significant difference test); average of 10 observations per run for each cultivar. There were five runs, and each run was a replication.

F. All Coleoptile Diameter (CDB, CDM, and CDT) and Length (CLGTH) Data.csv

Short Description: All coleoptile diameter and coleoptile length observations from the experiment.

G. Leaf Tip Surface Area Data.csv

Short Description: Subjective surface area measurements computed using software in a scanning electron microscope.

2. Relationship between Files: File A was derived from Files B, C, and D. File E was derived from file F.

3. Additional Related Data Collected that was not included in the Current Data Package:
None

4. Are there Multiple Versions of the Data Set? No

METHODOLOGICAL INFORMATION

1. Description of Methods used for Collection of Data:

Germplasm and Seed Selection

Seed of three hard red (winter growth habit) cultivars was harvested from plots in one block (15 x 30 m²) of a 2013 field experiment in Morrow County, Oregon. The three cultivars were Farnum, Finley, and Norwest 553. Farnum and Finley are standard height (tall) cultivars. Norwest 553 is a much shorter (semidwarf) cultivar. The short stature of Norwest 553 is a consequence of an intended mutation in the *Rht-B1* gene that interferes with the action or production of a plant growth hormone known as gibberellin.

Seed was removed from sampling bags used to store grain from the 2013 harvest. Shriveled, cracked, or broken seed, and seed with damaged embryos, was discarded. Ninety-six seeds of each cultivar were weighed individually. Seeds having a weight within one standard deviation of the mean were used for research.

Collection and Preparation of Soil

The soil used in this experiment was a Ritzville silt loam (*course-silty, mixed, superactive, mesic Calcidic Haploxeroll*). Collected soil was removed from the 0 to 100 mm depth of a tilled farm field (45.50 N; 119.87 W). Water was added to half the soil to bring the gravimetric water content up to 15%. Moistened soil was mixed by hand and divided among 10 large, heavy-duty (3 mm thick) construction-grade plastic bags. Remaining soil

was passed through a 2 mm sieve to remove clods, air-dried at 20° C for 10 days, and then placed in 20 L buckets. Plastic bags containing moist soil were sealed tight. Air-dried soil in buckets was covered with loose fitting lids. Soil in bags and buckets was stored in a cool (10° C) room until planting.

Planting Containers, Seed-Zone Details, and Seed Placement

A generic, thin-walled 4 x 30 cm plastic bag was compressed into the bottom of 165 cm³ planting cone (SC10 Ray Leach Cone-tainersTM) to plug drainage holes. A 100-mm-thick layer of moist soil was placed on top of the plastic and packed, using a wooden dowel, to an approximate bulk density of 1.3 g cm⁻³. A single wheat seed was carefully pressed, crease-side-down, into this artificial seed-zone and covered with a 25-mm-thick layer of moist soil, followed by a 75-mm-thick layer of sieved and air-dried soil.

Laboratory Set-Up and Collection of Emergence Force Data

Each planting cone containing soil and seed was inserted into another (empty) cone held upright in the center of a bucket filled with sand (**Figure 1-A**). Each bucket was raised from the laboratory bench using a scissor jack until the soil surface, at the lip of the planting cone, was almost in contact with a circular pad glued to the bottom of a small open-ended plexiglass box (**Figure 1-B**). The pad material (Part No. 703142; True Value Company; Chicago, Ill) provided a rough surface that prevented sideways growth of the emerging first leaf. The plexiglass box was used to connect the rough-surface-pad to a single-point (LCAE-600G; Stamford, CT) load cell. The load cell was made stationary by attachment to a piece of aluminum tubing connected to a 25 cm diameter steel rod welded to a wrought iron base-plate.

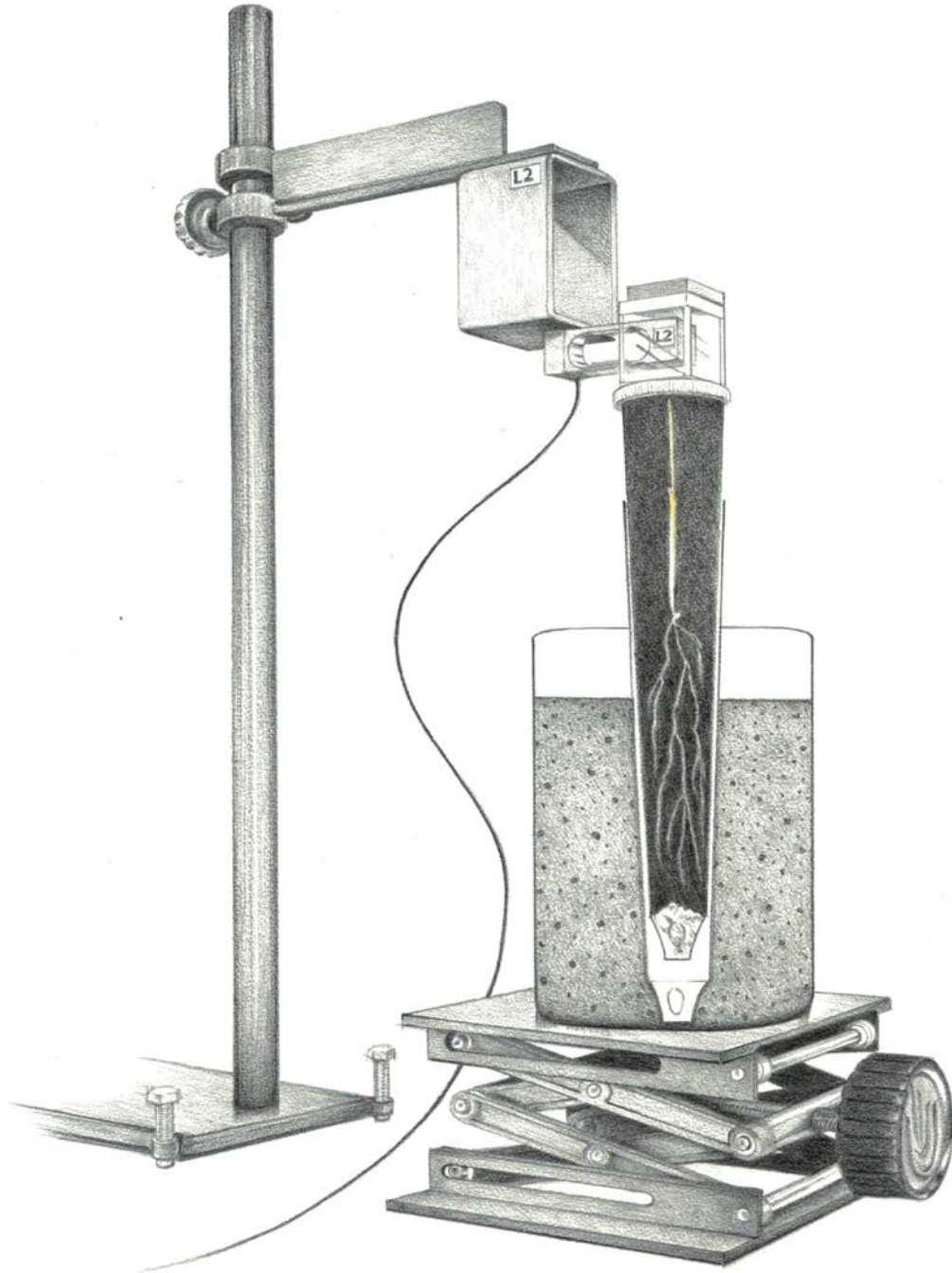


Figure 1-A. Illustration of benchtop method for collection of emergence force data.

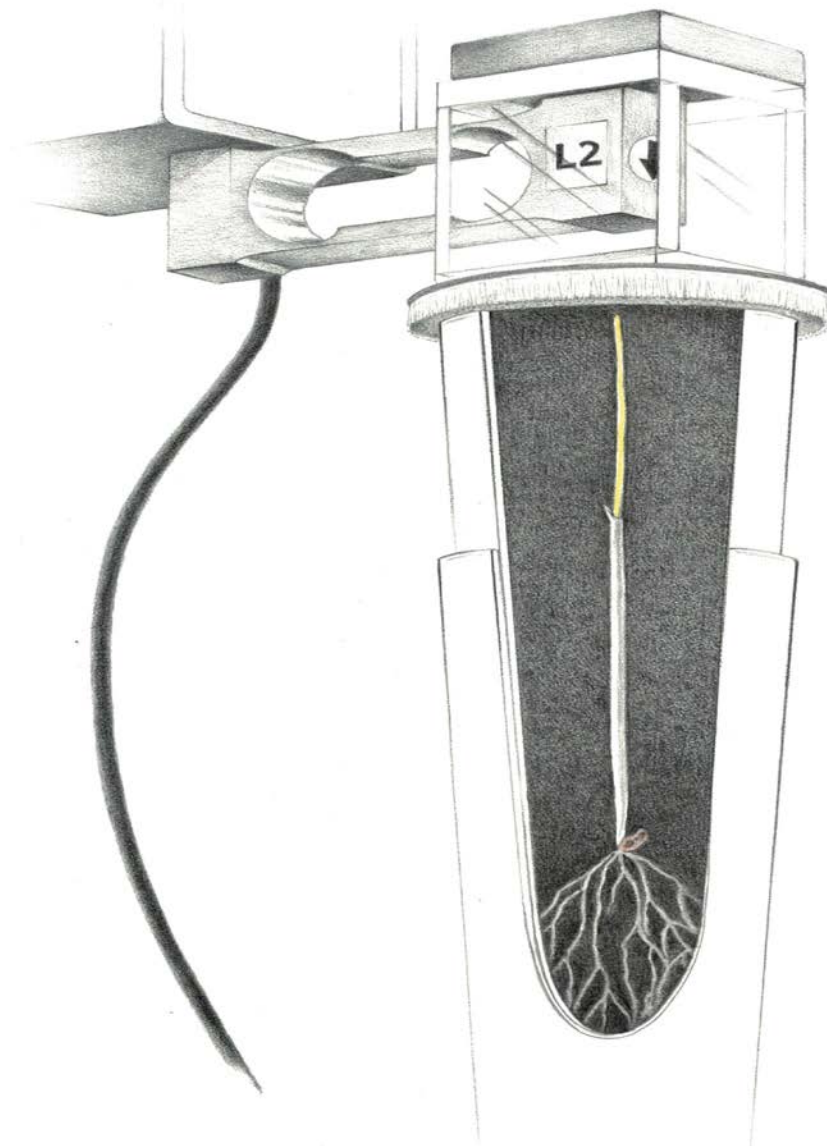


Figure 1-B. Close-up illustration of planting cone, emerging first leaf, and load cell configuration.

The weight of the plexiglass box and rough-surface-pad, attached to each load cell, ranged from 48 to 94 g and was the baseline gravitational force value of output. This baseline reading was reduced by an amount equal to the upward force of the emerging first leaf. The upward force is reported using units of mass (g), instead of dynes, because it is consistent with what has been done in the past [Gerard, 1980; Williams, 1956; Williams, 1963].

First leaf emergence force data were collected from a randomized complete block design with three treatments (cultivars) and nine replications. Each replication was a block. Each block was defined as a “run.” Each run was conducted for ten days. Emergence force was measured at two minute intervals until 8 to 10 hours after first leaves buckled (**Figure 2**). Data were collected using six load cells (two randomly-selected load cells per cultivar) during each run. Emergence force data from the two load cells for each cultivar were averaged and recorded as one observation.

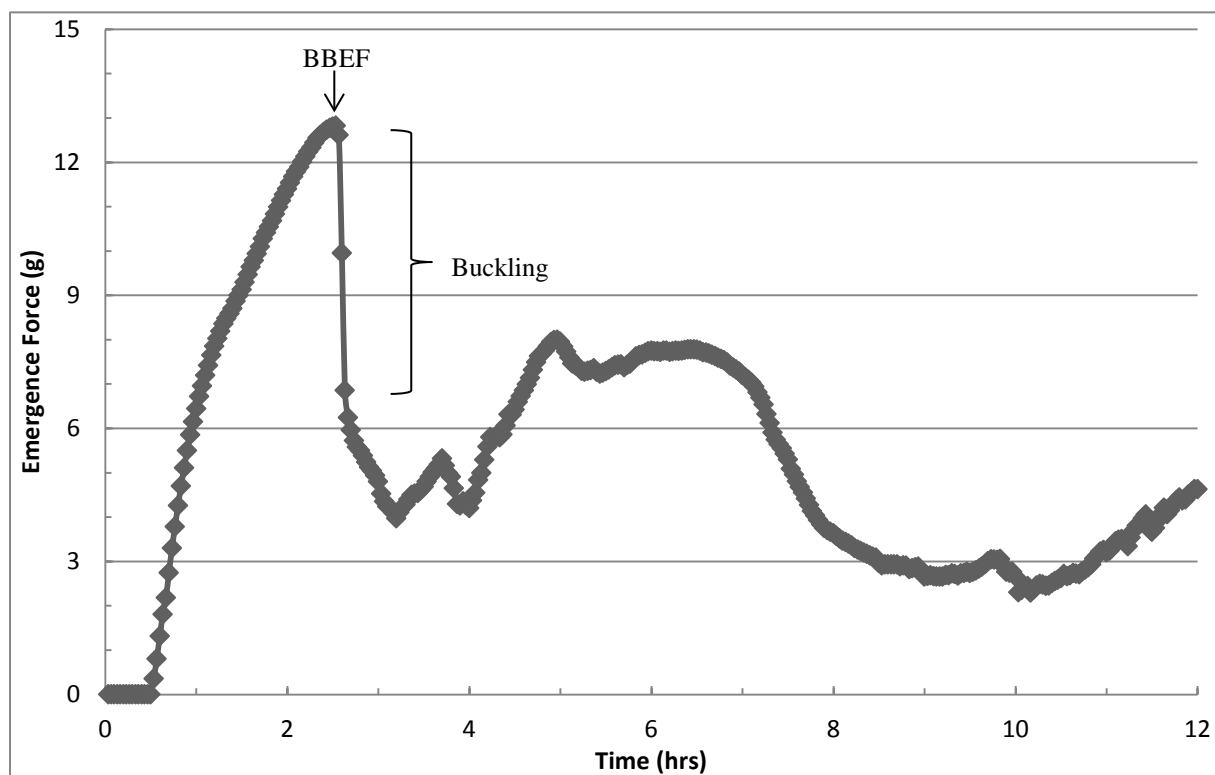


Figure 2. First leaf emergence force of Finley measured by one of the load cells used during the second run. Before buckling emergence force (BBEF) occurred after a 13 gram increase, and just before a sudden 7 gram decrease, in load cell output. This figure was plotted using data from column F of file C (*All Emergence Force Data for Finley Hard Red Winter Wheat*).

Coleoptile Diameter

Coleoptile diameter was determined using a 0 to 25 mm, ratchet-stop 102-301 micrometer (Mitutoyo America Corporation; Aurora, Ill). Diameter measurements were made five mm

above the base, in the middle, and five mm below the tip of the coleoptile. Data were obtained from 10-day-old seedlings propagated in the dark, in folded and moistened 25 × 38 cm, heavy-grade germination paper (Anchor Paper Co., Saint Paul, MN), and at constant (22° C) temperature [Mohan et al., 2013]. Data were collected during five runs. Measurements from a random selection of 10 of the 15 coleoptiles of each cultivar (per run) were averaged and recorded as one observation.

Leaf-tip Images and Surface Area

Images of the tip of nine first leaves (three per cultivar) were made with a Quanta 600 reduced pressure SEM housed in the Linus Pauling Science Center at Oregon State University in Corvallis. Software in the SEM automatically computed the surface area of a subjective (operator-selected) segment of the tip of the first leaf.

Statistical Analysis

The Statistix 10 program (Analytical Software; Tallahassee, FL) was used to interpret independent and normally distributed data. The assumption of homogeneity of variance was verified using Bartlett's test [Bartlett, 1937; Li et al., 2015]. Sources of variation in BBEF were determined using an analysis of variance model for a balanced RCB-9 design. A similar (RCB-5) model was utilized for coleoptile diameter measurements. Treatment means were compared using Tukey's honestly significant difference ($\alpha = 0.05$) test [Carmer and Walker, 1985]. Simple descriptive statistics were used to make a preliminary assessment of the surface area of leaf tips.

References

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- Williams WA. 1963. The emergence force of forage legume seedlings and their response to temperature. *Crop Sci*. 3: 472-474.

DATA-SPECIFIC INFORMATION FOR FILES

File A: Before Buckling Emergence Force (BBEF) Data.csv

1. Number of Variables: Three (3)
2. Number of Cases/Rows: 27
3. Variable List
 - Name: **Cultivar**
Description of Variable: Unique germplasm or variety of hard red winter wheat
Labels: Farnum, Finley, and Norwest 553
 - Name: **Run**
Description of Variable: Each run is a replication
Value or Identifier: 1-9
 - Name: **BBEF**
Description of Variable: Before buckling emergence force (grams).

File B: All Emergence Force Data for Farnum Hard Red Winter Wheat.csv

File C: All Emergence Force Data for Finley Hard Red Winter Wheat.csv

File D: All Emergence Force Data for Norwest 553 Hard Red Winter Wheat.csv

1. Number of Variables: 28
2. Number of Cases/Rows: 360
3. Variable List
 - Name: **Time**
Description of Variable: Time (hours)
 - Name: **R101**
Description of Variable: Data (grams) from the first randomly-selected load cell during run 1
 - Name: **R102**
Description of Variable: Data (grams) from the second randomly-selected load cell during run 1
 - Name: **Mean**
Description of Variable: Mean of R101 and R102

 - Name: **R201**
Description of Variable: Data (grams) from the first randomly-selected load cell during run 2
 - Name: **R202**
Description of Variable: Data (grams) from the second randomly-selected load cell during run 2
 - Name: **Mean**
Description of Variable: Mean of R201 and R202

Name: **R301**

Description of Variable: Data (grams) from the first randomly-selected load cell during run 3

Name: **R302**

Description of Variable: Data (grams) from the second randomly-selected load cell during run 3

Name: **Mean**

Description of Variable: Mean of R301 and R302

Name: **R401**

Description of Variable: Data (grams) from the first randomly-selected load cell during run 4

Name: **R402**

Description of Variable: Data (grams) from the second randomly-selected load cell during run 4

Name: **Mean**

Description of Variable: Mean of R401 and R402

Name: **R501**

Description of Variable: Data (grams) from the first randomly-selected load cell during run 5

Name: **R502**

Description of Variable: Data (grams) from the second randomly-selected load cell during run 5

Name: **Mean**

Description of Variable: Mean of R501 and R502

Name: **R601**

Description of Variable: Data (grams) from the first randomly-selected load cell during run 6

Name: **R602**

Description of Variable: Data (grams) from the second randomly-selected load cell during run 6

Name: **Mean**

Description of Variable: Mean of R601 and R602

Name: **R701**

Description of Variable: Data (grams) from the first randomly-selected load cell during run 7

Name: **R702**

Description of Variable: Data (grams) from the second randomly-selected load cell during run 7

Name: **Mean**

Description of Variable: Mean of R701 and R702

Name: **R801**

Description of Variable: Data (grams) from the first randomly-selected load cell during run 8

Name: **R802**

Description of Variable: Data (grams) from the second randomly-selected load cell during run 8

Name: **Mean**

Description of Variable: Mean of R801 and R802

Name: **R901**

Description of Variable: Data (grams) from the first randomly-selected load cell during run 9

Name: **R902**

Description of Variable: Data (grams) from the second randomly-selected load cell during run 9

Name: **Mean**

Description of Variable: Mean of R901 and R902

File E: Coleoptile Diameter (CDB, CDM, and CDT) and Length (CLGTH) Data.csv

File F: All Coleoptile Diameter (CDB, CDM, and CDT) and Length (CLGTH) Data.csv

1. Number of Variables: Six (6)

2. Number of Cases/Rows:

a. File E: 15

b. File F: 150

3. Variable List

Name: **Cultivar**

Description of Variable: Unique germplasm or variety of hard red winter wheat

Labels: Farnum, Finley, and Norwest 553

Name: **Run**

Description of Variable: Each run is a replication

Value or Identifier: 1-5

Name: **CDB**

Description of Variable: Diameter measurement (mm) above the base of the coleoptile

Name: **CDM**

Description of Variable: Diameter measurement (mm) at the middle of the coleoptile

Name: **CDT**

Description of Variable: Diameter measurement (mm) below the tip of the coleoptile

Name: **CLGTH**

Description of Variable: Length of the coleoptile (mm)

File G: Leaf Tip Surface Area Data.csv

1. Number of Variables: Two (2)

2. Number of Cases/Rows: 9

3. Variable List

Name: **Cultivar**

Description of Variable: Unique germplasm or variety of hard red winter wheat

Labels: Farnum, Finley, and Norwest 553

Name: **TIPSA**

Description of Variable: Approximate surface area (thousand μm^2) of the tip of the first leaf